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WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR. MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

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NOTES AND COMMENTS.

War and Industry.

Behind thoughts of almost everything now runs the persistent question, "How will the war affect it?" As is to be expected, there is scarcely an industry which is not experiencing some disturbing effect from the present regrettable position. The fabric of modern industry is so closely interwoven with international interests that the effects on any industry of a war involving nearly all the great industrial countries of Europe is incalculable. Thanks to her command of the sea and her geographical position, however, Great Britain is likely to be the least affected of the belligerents, at any rate as regards the immediate disturbance of her industrial activities. Nevertheless it is interesting and instructive to examine the immediate situation for any indications of possible tendencies and likely effects.

Enquiries among the trades with which we are most concerned, *i.e.*, the foundry and allied trades, reveal the fact that the effects of the present conditions are very varied. In some directions a distinct stimulus has been given, by reason of a sudden demand created by the change from peaceful industrial activity to war. But in other directions the change has involved a temporary cessation, or at least reduction of demand. Activity, naturally, is experienced by foundries associated with the armament centres, while only a restricted activity is felt in shipbuilding centres. In some Midland areas, on the other hand, a temporary lull is inevitable until industry settles down to the new conditions. Foundries dealing with the requirements of general engineering are variously affected, according to situation and nature of work. A prominent feature with almost all industries is the checking of all business savoring at all of a speculative character, actual demand being the basis of works' activities. It is this latter fact that explains the irregularities of pressure in different industries, for in normal times with credit undisturbed, much manufacturing production must essentially be of a somewhat speculative character, in that it is calculated to meet expected requirements rather than immediate demands. In the event of any financial disturbance, such as is to some extent inevitable for a time in the present circumstances, such business is the first to receive a check. With the restoration of public confidence most industries will certainly resume their normal course; and in fact they must do so if the war is to be conducted successfully. It is vital that the production of the requirements of the country be continued as far as possible normally; not only so far as concerns the production of what we consume ourselves, but also in regard to those goods and manufactures which we exchange in the world's markets for products we could not otherwise obtain. We do not propose at the moment to discuss the steps which it is desirable for the Government to take, or which it has already taken, to re-establish and maintain that confidence which is so essential to the conduct of a nation's industries; there is evidence that what steps are found necessary will be taken in due course. At the moment the only sound policy for works is to continue as nearly normal in operation as possible.

A Business Aspect of the War.

Under some stimulus from official sources, British manufacturers are now becoming keenly alive to the possibilities of a far wider British trade in overseas markets. In plunging into this wild and suicidal conflict, Germany has thrown open to the attack of her British industrial opponents a large number of neutral markets in which she has been developing a very extensive business. In the face of the British dominance of the seas and the fact that our trade routes practically all remain open, while those of Germany and Austria are closed, the continuance of Germany's vast export trade is impossible. The damage to her powers of production, her mercantile marine, and also to her international prestige, which may be predicted, will, moreover, prevent the ready resumption of her foreign trade at the conclusion of hostilities, particularly if British manufacturers take the present opportunity of establishing themselves in the markets in question.

As regards the effect on our own iron and steel industries of this disturbance of German export trade, some idea of the possibilities may be gathered from an examination of the export figures for 1913. In that year Germany exported about 6,500,000 tons of iron and steel of various descriptions, and also over half a million tons of machinery and engines. Her imports only amounted to 618,000 tons of iron and steel and about 88,000 tons of machinery and engines. In pig-iron and ferro-alloys the balance of exports over imports was 730,000 tons, while the figures for some foundry and similar products were as follows:—

	Imports.	Exports.	Excess of exports.
	Tons.	Tons.	Tons.
Cast pipes and fittings	850	79,962	79,112
Cast rolls	1,489	13,743	12,254
Cast machinery parts	8,073	6,359	*
Other castings	10,955	109,514	98,559
Domestic fire grates	327	32,075	31,748
Malleable castings and forgings, &c.	22,639	176,015	153,376
Anchors, anvils, vises, &c.	1,421	10,619	9,198
Agricultural machinery	1,610	54,636	53,026
Tools and instruments	1,760	25,956	24,196
Machinery and Engines	87,900	594,314	506,414

* Excess of imports = 1,714 tons.

In the absence of details it is impossible to give accurate figures on the purely foundry products, but the foregoing will give some idea of the extent of Germany's foreign trade in foundry goods. The last four items of the above table, of course, are not the work of the founder, but they all largely employ the founder in the production of some of their parts. Machinery and engines in particular are, in their manufacture, largely dependent on the foundry. As regards the countries to which these products were exported, the next table shows the excess of exports to, over imports from, the countries concerned, the figures thus representing the net supplies of these commodities by Germany to other countries. It will be seen that even in neutral markets there is considerable trade which might be captured, while there are also certain quantities which last year were imported into this country from Germany, but which our own manufacturers will now have to supply.

So far as Austria-Hungary is concerned, the exports of iron and steel from those countries are not in serious competition with our own in the markets which will now be open for trade. In any case the Austro-Hungarian exports of pig-iron and all manufactured descriptions of iron and steel total less than 150,000 tons yearly, of which less than 1,000 tons represents cast material.

There is also this regrettable consideration to be borne in mind, viz., that Belgium will perforce for a time be unable to maintain her exports of iron and steel, which amounted last year to about 727,000 tons in excess of her imports of those materials. The majority of this, of course, was rolled and similar manufactured descriptions, but the steel-casting trade which has been in such serious competition with Sheffield of late years cannot at present be so regarded, and Great Britain must supply that portion of her own requirements for which she has previously imported from Belgium.

It will thus readily be seen that Great Britain is the only one of the belligerent nations in a position to maintain her external commence in iron and steel, so that despite temporary disorganisation due to the suddenness with which affairs have developed, we must look for considerable activity in many branches in the near future. Moreover, that activity may quite well be developed into a permanent expansion of our foreign trade if the opportunity is handled in the right manner. But, as is being impressed upon us from many quarters, it must not be supposed that the mere absence, at the moment, of German competition, will place those markets in our hands. British manufacturers have still much to learn in the matter of business methods and international competition, though they are beginning to realise that quality alone will not always win.

Net German Exports to	Cast pipes and fittings.	Cast rolls.	Cast Machinery parts.	Other castings.	Malleable castings and forgings.	Domestic fire grates.	Anchors anvils, vises, &c.	Agricultural machinery.	Tools and Instruments.	Machinery and engines.	Total all iron and steel.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Great Britain	453	295	*	†	24,358	5,344	1 325	—	1.383	§	1,011,194
Belgium	2,002	4,004	*	11,054	11,281	1,007	786	863	1,378	29,646	570,566
Denmark	5,966	—	—	2,302	3,562	384	—	671	194	8,965	177,999
France	285	3,120	719	7,365	12,180	1,084	901	1,249	1,874	58,013	219,793
Italy	3,541	1,962	—	9,243	8,102	974	254	3,701	1,537	29,670	319,301
Holland	23,495	—	399	14,702	17,256	2,491	753	2,065	897	28,992	561,010
Norway	2,139	—	—	1,104	2,218	93	—	—	39	5,695	113,410
Sweden	6,450	—	—	1,806	‡	—	—	—	38	6,376	76,252
Austria-Hungary	7,200	546	1,129	9,497	5,712	721	777	1,805	2,219	64,046	354,968
Roumania	3,229	—	—	3,253	2,893	93	—	2,361	242	14,515	146,481
Russia and Finland	1,424	448	—	6,942	7,471	2,014	1,555	23,966	5,593	116,439	268,920
Switzerland	3,043	—	1,205	7,546	9,954	264	351	527	529	10,512	338,595
Spain	—	—	—	1,794	2,041	596	—	223	302	21,211	79,002
Brazil and Argentine	6,916	—	—	5,260	11,150	3,016	275	635	1,656	33,873	504,786
British East Indies	—	483	—	2,114	4,863	761	—	—	216	1,900	215,383
China and Japan	—	—	—	2,552	6,078	676	—	—	—	11,922	316,033

* Excess of imports from { Great Britain = 1,470 tons. Belgium = 2,071 „

† „ „ „ Great Britain = 400 „

‡ Excess of Imports from Sweden = 689 tons.

§ „ „ „ Great Britain = 2,861 „

Heat Treatment and Test Shops at Allensbank Works.

The recently completed departments for heat-treating and testing the component parts of hammer drills, form an interesting and important addition to the Cardiff works of the Flottmann Engineering Company, Limited. In the production of hammer drills for mining, for which this firm is so well known, it would appear that owing to the recent advances in speed and efficiency the reduction of maintenance costs is the only direction in which material improvement can be effected. Obviously the wear and tear upon the component parts of the drill has risen proportionately with the speeding up; so that a steel which met every requirement in the hammer drill of a few years ago, would be wholly unsuitable in the tool of to-day.

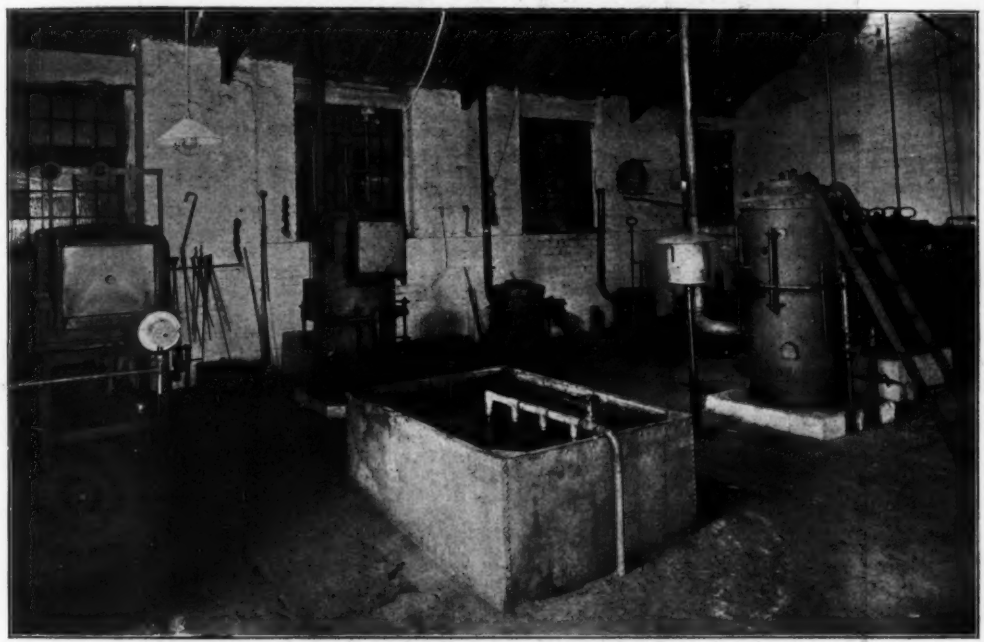


FIG. 1.—VIEW IN HARDENING SHOP; ALLENSBANK WORKS.

The necessity of the standardisation of a system of heat treatment, combined with a simple and at the same time reliable means of testing the finished parts, constitutes the underlying principle in the design of the apparatus, the installation of which the Flottmann Engineering Company have recently completed. The heat-treatment shop and the test house adjoin, occupying a building on the opposite side of the yard to the firm's main shops. The test house equipment includes a Heraeus electric resistance furnace, served by a recording pyrometer, a Shore scleroscope, a hydraulic testing machine giving direct readings for Brinell hardness and tensile tests, and a complete micrographic apparatus.

Each bar of steel is tested before being passed into the shops; the test being made by cutting a piece of the bar longitudinally and forging the two portions—the one with, and the other transverse to, the direction of the rolling. Each piece after being submitted to the Brinell test is broken, and the fractures examined under the microscope. Tensile tests are also made at frequent intervals. This preliminary testing of each bar naturally involves a considerable amount of labour, but though the chemical composition of two bars is identical, the physical properties may vary considerably, and as a dozen or more pistons are made from the one bar, the expense of the preliminary test is the lesser evil. With each batch of finished parts a test piece is made for treatment in the Heraeus furnace, a record being taken of the hardening point and the subsequent treatment determined thereby.

The equipment of the heat-treatment shop comprises an oven furnace, used for warming and annealing only, and a gas-fired salt-bath furnace in which the whole of the hardening is done. This not only ensures an uniform degree of heating, but prevents the formation of scale during such heating. The temperature of the bath is taken with a recording pyrometer. Beyond the hardening furnace is a gas-fired annealing furnace, and beyond this again a gas-fired oil-bath tempering furnace, each of the latter being fitted with pyrometers.

The centre of the shop is taken up with the case-hardening plant, and this—as indeed the whole of the furnaces, with the exception of the oven furnace first mentioned—was built in the Company's shops. The particular system adopted for case-

hardening is the outcome of experiments on which the management have been engaged for the past three years, and, naturally enough, details are not available.

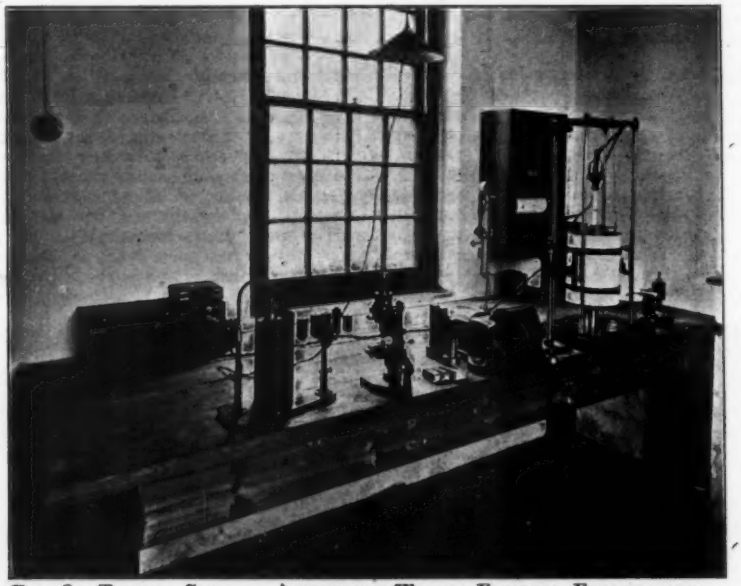


FIG. 2.—TESTING SHOP AT ALLENSBANK WORKS. ELECTRIC FURNACE AND PYROMETER.

After polishing, the finished parts are returned to the test house, where they are calibrated and tested for hardness on the Shore scleroscope, no part being passed which shows a variation of three degrees on either side of the point of hardness which has been found most suitable for the duty the particular part will have to perform. This hardness testing can be carried out very rapidly and calls for no special skill on the part of the operator, as the scleroscope gives visual readings on a graduated scale. In a batch of pistons taken from stock and tested for the benefit of our representative, the greatest variation shown was two degrees, the bulk of the sample being within one degree of the predetermined point. It will thus be seen that whilst the parts in the semi-manufactured and finished states are systematically tested, the individual tests are so simple as to leave little room for the human error.

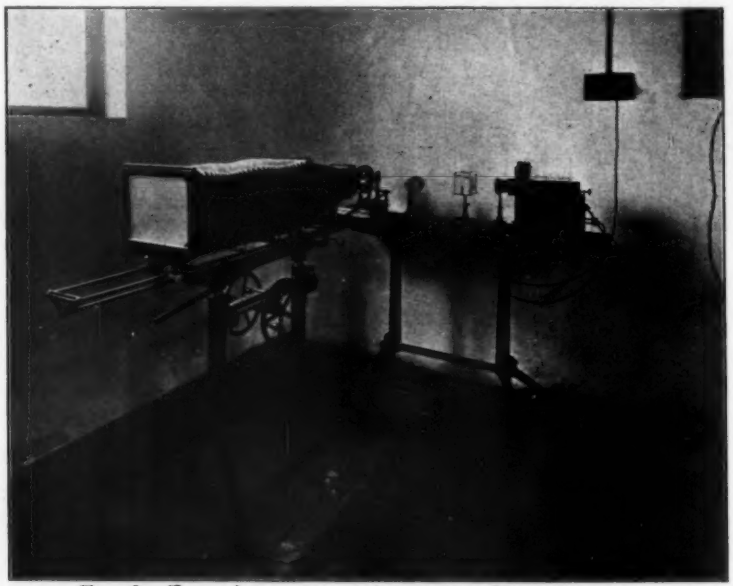


FIG. 3.—ZEISS APPARATUS AT ALLENSBANK WORKS.

National Relief Fund.

The Prince of Wales' Fund now stands at about £2,000,000, and this does not include many sums that have been collected locally and not yet sent to swell the aggregate at Buckingham Palace Of this large sum, employers and employed in the iron, steel and engineering industries have contributed freely, while the individual efforts made by employers for the benefit of their workpeople, and the sacrifices made by the employés themselves, are more than praiseworthy and indicate the desire of all concerned to alleviate the suffering that must necessarily follow in the wake of a war, the immensity of which can hardly be conceived. In this respect it is interesting to record the following such cases:—

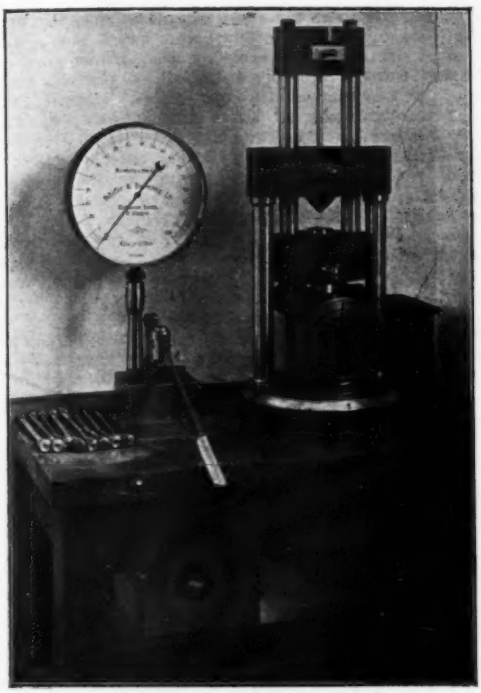


FIG. 5.—TENSILE AND BRINELL TESTING APPARATUS.

The men employed at the Coventry Ordnance Works have decided to make a weekly subscription, 75 per cent. of the total collected to go to the National Fund, and 25 per cent. to the local fund.

The Anglo-French nickel workmen at Swansea are making the following contributions:—Men earning 40s. and over, 6d. per week; 30s., 4d.; 25s., 3d.; 20s., 2d.; and all under, 1d.

Vickers, Limited, are paying weekly to the wives, families, and other dependents of their employés who have been called up an allowance similar to that paid by the Government by way of separation allowance.

The Consett Iron Company, Limited, have issued a notice stating that the places of all men who have gone to the front in any capacity will be kept open for them.

The workmen employed by Newton, Chambers & Company, Limited, will contribute 2d. and 1d. each man and boy respectively per week. The firm are keeping the places of the men open, and making provision for the wives and families.

The workmen and staff of Cammell, Laird & Company, Limited, at Birkenhead, numbering nearly 10,000 men, have arranged through the medium of their Works Committee, to make the following weekly contributions to the fund:—Those receiving 35s. per week and over, 6d.; between 30s. and 30s., 4d.; between 30s and 25s., 2d.; less than 25s., 1d.

The Glengarnock Iron and Steel Company, Limited, Glengarnock, are paying half wages to the dependents of their men called up.

Seebohm & Dieckstahl, Limited, in addition to keeping the men's places open, are contributing 10s. per week to each wife and 1s. for each child.

The following is our first list of subscriptions to the Prince of Wales' Fund:—

£10,000 each; Sir Robert Hadfield; Guest, Keen & Nettlefolds, Limited.

£3,000 each:—Wm. Baird & Company, Limited; Stewarts & Lloyds, Limited.

£2,500 each:—Birmingham Small Arms Company, Limited; Daimler Company, Limited; Cammell, Laird & Company, Limited; John Brown & Company, Limited; Sir W. G. Armstrong, Whitworth & Company, Limited; Vickers, Limited.

£2,000 each:—North British Locomotive Company, Limited; Arthur Keen; H. & R. Merton.

£1,050 each:—Babcock & Wilcox, Limited; William Beardmore: J. Stone & Company, Limited; Howard & Bullough, Limited.

£1,000 each:—Sir Wm. Houldsworth; Sir Hugh Bell; Sir Wm. H. Stephenson; Bolckow, Vaughan & Company, Limited; Sir Geo. Bullough; G. & J. Weir, Limited; Hawthorn, Leslie & Company, Limited; Mr. Ruston, Lincoln; Mr. Shuttleworth, Lincoln; Sir Wm. Arrol & Company, Limited; Hugh Reid (N.B. Loco. Works); Andrew T. Reid (N.B. Loco. Works); Sir Andrew Noble; Andrew Carnegie; Thos. Firth & Sons, Limited; Coventry Ordnance Works, Limited; Islip Iron Company, Limited; Birmingham Battery and Metal Company, Limited; George Tangye; Stanton Ironworks, Limited; Dorman, Long & Company, Limited; Sir Arthur B. Markham; Fairfield Shipbuilding and Engineering Company, Limited; William Baird; Mond Nickel Company, Limited; Redpath, Brown & Company, Limited; Pease & Partners, Limited; Duke of Devonshire.

£525:—National Radiator Company, Limited.

£500 each:—Walter M. W. Reid (N.B. Loco. Works); E. R. Merton; Morgan Crucible Company, Limited; C. Morcom; John Wright & Company; Parson's Marine Steam Turbine Company, Limited; Richmond Gas Stove and Meter Company, Limited; Z. Merton; John Spencer & Sons, Limited; Bow, McLachlan & Company, Limited; Newton, Chambers & Company, Limited; Walter McFarlane & Company, Limited; Tangyes, Limited; Monk Bridge Iron and Steel Company, Limited; Steel, Peech & Tozer, Limited.

£300 each:—Sir Francis Ley; Mechan & Sons, Limited.

£262 10s.:—British Aluminium Company, Limited.

£250 each:—Mackenzie & Moncur, Limited; D. Rowan & Company; J. Fowler & Company (Leeds), Limited; Doulton & Company, Limited; Parkinson and W. & B. Cowan & Company, Limited; Bullers, Limited; Manganese Bronze and Brass Company, Limited; The Mint, Birmingham, Limited; Anderston Foundry Company, Limited; W. & T. Avery, Limited; Wm. Tangye; N. Hingley & Sons, Limited.

£200:—Thos. Shanks & Company.

£105 each:— Thos. Piggott & Company, Limited; J. & E. Wright, Limited; E. Parkes & Company, Limited; Sir J. S. Randles; Hunslet Engine Company, Limited

£100 each:—J. Reynolds & Sons, Limited; A. R. Brown, McFarlane & Company, Limited; Dobbie McInnes, Limited; Falkirk Iron Company, Limited; Abbot's Foundry Company.

£50 each:—Crawley, Parsons & Company; M. Harvey & Company; Wm. Kenrick; W. & J. Lawley.

Core-Boxes and Core-Making.

By D. Gordon, A.M.I.Mar.E.

(*Continued from page* 536.)

Core-boxes in wood for making the smaller diameters of circular cores are made up in every respect similar to those described for the square or oblong sections. Fig. 1, compared with Fig. 16, illustrates this. Further, the remarks regarding the direction of the grain apply equally to these two core-boxes, as obviously the difference is only one of sectional form.

When diameters larger than can be conveniently cut from a 3-in. thick board are required, the fuller thickness is made up as shown in Fig. 17, the side pieces *a a* being only of sufficient width to allow

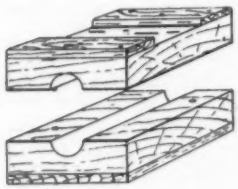


Fig. 16.

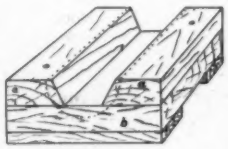


Fig. 17.

of the full formation of the hole. These pieces are glued and screwed to a main body board which also contains a portion of the hole, but with the grain running in a transverse direction to the side pieces. This method of making up a required thickness economises material, as two full-width boards are unnecessary, and reduces production costs, both as regards labour and time, owing to the elimination of a heavy body of material from the centre. Also it obviates twisting and warping defects, since one portion of the material counteracts any such tendencies in the other. The main body portion *b* is also, upon its other surface, battened as shown, to give added stiffness. The disadvantage of this crossing of material is chiefly that due to variations of shrinkage, but as this, in its results, is the lesser of two evils, the transversing is more frequently adopted in preference to having the grain all in one direction.

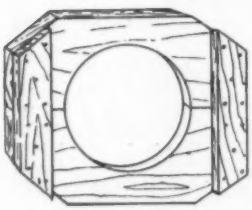


Fig. 18.

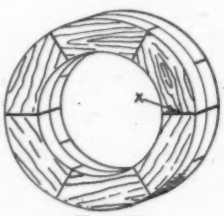


Fig. 19.

Boxes for cores of larger sectional diameters but of lesser thicknesses are made up, if under 3 in. in thickness, from the solid material, or alternatively, if a stronger formation is required, by means of segments. No arbitrary rule can be set down for the adoption of either method, beyond that a segmentally-formed box is considerably stronger and not limited to any diameter, as would be the case with a box formed from the solid material, the limitations of the latter being set by the widths of two boards, owing to the great waste that must result if three or more boards are necessary to obtain larger diameters. The common practice in making these boxes from the solid is to part the box centrally, a semicircle being cut in each piece, this allowing every facility for quick removal of the surplus "stuff." They are usually strengthened by means of battens, and their weight reduced by very heavily cutting away the corners as shown in Fig. 18. In some instances they are dowelled upon the joints for core relief purposes, but if not, a butt or open joint only is necessary, the battens in every respect being preferably retained, to prevent warping and twisting of the material. Boxes of this character are not to be depended upon, as they very quickly lose their true form, owing to alternate shrinking and swelling. These defects are to a great extent obviated by building up the work in segments, which method beside being stronger has no limits for length or diameter, though it is more costly in production. This class of core-box is invariably built and turned upon the lathe as the most expeditious method, the segments generally being glued and nailed together. When required to be jointed they are as a rule made as fully built-up rings, but are not turned to the finished diameter, this being done after the joint *x* has been made by severing the fully built-up work, Fig. 19.

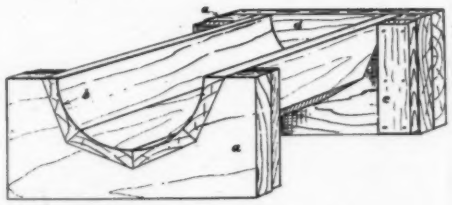


Fig. 20.

In general practice cores of large cylindrical form are struck up in loam, but when required in green or dry sand they are preferably made within a box, which latter is made up by means of lags fitted within end pieces cut to receive them. An example of this type of box is shown in Fig. 20, *a a* being the end pieces or "bridges" which carry the lags *b*, which latter are glued and firmly screwed to the ends. To strengthen these ends, which becomes necessary owing to the shortness of grain due to the cut-out polygonal form of the lags, battens *c* are screwed, transversely, to them.

This polygonal formation of lagging is not always adopted, for by this method the lags are required to be more or less of the same width, as will be obvious even if the joints are made open. As this method may not always be convenient, a circular seating, as distinct from the polygonal, is adopted, this allowing the lags to be of any width. This method, Fig. 21, although convenient, is more costly, owing to the circular fitting of the lags which, if the ends only are made to fit within the circular end pieces takes considerably longer than the flat bedding of the polygonal form.

As a rule, only one half core-box is supplied for making this type of core, it being made in halves, and, after drying, a full core formed by pasting and binding together by means of the grids in each half. As will be readily understood, it becomes necessary in the circumstances to enclose the ends of the half box to retain the sand during the making up, and covering pieces as *d* (Fig. 20) are screwed to the end bridges for this purpose. When the end plates *d* carry projections which necessitate their removal previous to relieving the core, this method of attachment is not altogether satisfactory, for it must be remembered this class of box would not be made for

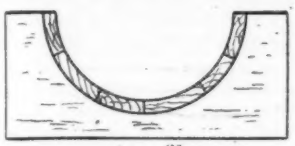


FIG. 21.

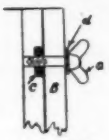


FIG. 22.

small orders; therefore the end plates are attached and detached in a more satisfactory manner by means of fly bolts *a*, Fig. 22, which pass through closely-fitted holes drilled in the end plate *B* and screw into plates *C* which are fixed to the bridge ends. The washer *d* takes the wear of the screw head and ensures a rigid grip.

Struck-up circular cores are made either horizontally by means of the core lathe, or vertically by means of a revolving striking board attached freely to a fixed spindle. This latter method is more generally applicable to cores built upon a foundation plate, which plate also carries the main mould structure. It is, of course, admitted that this procedure is not always followed, as many of the heavier cores which require setting within a mould are more conveniently made in the core lathe. The choice of methods is largely governed by factors which make abitrary statements misleading.

By making cores by means of a core-lathe the pattern costs are reduced to a minimum, as only striking-up boards cut to the sectional contour of the

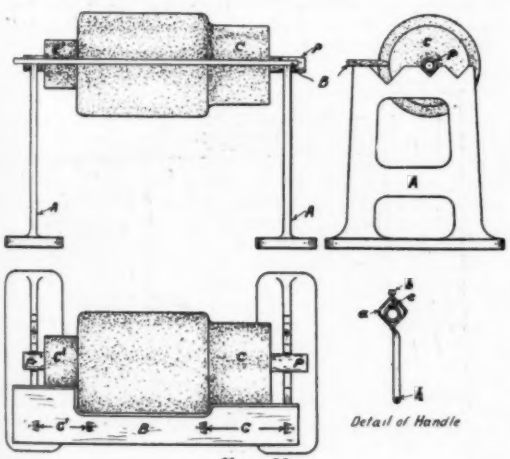


FIG. 23.

required core are necessary. These boards are chamfered along their striking edges, as by reducing the edge thickness a cleaner face is given to the surface of the core. This edge thickness does not exceed $\frac{1}{8}$ in. to $\frac{1}{16}$ in., but the thickness of the striking board depends entirely upon the rigidity necessary to keep the striking edge straight. In Fig. 23 a common form of core-lathe is shown, this being composed of two independent trestles, *A A*, vee cuts of different sizes being made in the upper edges to form the bearings for the centre core-barrel *P*. This core-barrel is perforated around its periphery and through its entire length, to allow the escape of air or gases from the core. The core is then built round the barrel by first binding various layers of straw-band roughly to the shape of the core, this being afterwards covered over with loam and revolved. The striking-up board *B* is advanced towards the revolving mass, sweeping away the surplus material to the board shape along its edge. The required core diameters at its extremities are marked upon the board surface as *C*¹ *C*. These measurements are cut into the board so that the calipers extending from cut mark to cut mark are correctly set. Any intervening dimensions depend obviously upon the striking board, as it is cut in relation to its ends.

The methods for revolving the barrel during the striking-up processes are in many cases crude, as for example the wedging in at one end of a piece of bent iron to act as the driving handle. A cheap and efficient form of handle is shown in Fig. 23, which is of wrought iron bent at one extremity to a square formation *a* and at one of its corners screwed to receive a bo't *b*, which at one end has attached a loose grip-piece *c*, this latter binding on to the barrel as the bolt is screwed down. At the other end,

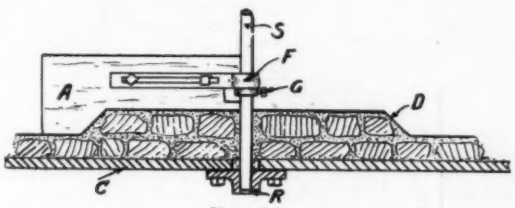


FIG. 24.

h, a handle lever is attached. This form of handle is thus able to grip upon various sizes of core-barrels, and is more economical to adopt than the slip-shod methods so commonly seen.

The principles involved in striking up cores in the vertical direction are in every case the same, but the applications differ according to core size, shape, and moulding conveniences. In this latter respect many loam cores are struck up direct upon a foundation plate, which also carries the main mould structure (the latter having been previously formed and removed), both for drying purposes and also for convenience in striking up the core. In some cases the core is formed upon a special seating which acts as register for defining the relative position of the mould and core. This is not always necessary, as the core may be formed direct upon the foundation plate, the relative position of the mould being ascertained by other means. As an example (open to various modifications), Fig. 24 shows in section a foundation plate *C* which has a centre cored-out hole to allow a spindle *S* to pass through and bed into a spindle-run *R*, this latter being fixed to the plate by means of bolts, etc. The plate *C* is also perforated at various positions to allow air or gases to be drawn away from the bottom by means of vent pipes carried to the upper surfaces of the mould. Also, projecting lugs, cast on the plate, are required around the periphery—assuming the plate to be circular—for lifting purposes, as when fully formed the

mould is generally lifted and placed into a pit, and pit-rammed for casting. A layer of loam is daubed over the one surface of the plate *C* and a course of bricks bedded into it, the interstices between the bricks being packed with cinders and loam. This course of bricks is covered with loam and another layer following out the core diameter is bedded upon them. A seating board *A* cut to the radius of the core and stepped as *D*, is attached to the spindle-arm *F*, and the board position is defined by means of the collar *G*, which is "hard screwed," to the spindle, giving bearing to the boss of the arm *F*. Loam is placed over the last-built brick course and the board *A* when rotated sweeps up a seating corresponding in shape to the striking edge of the board. At this stage the board *A* is removed and the loam seating stoved and dried, after which the mould is proceeded with previous to forming the core proper. Continuing with the completion of the core, a striking-up board *B*, Fig. 25, is attached to the spindle, the length of its vertical striking edge being the required core length. To prevent movement of the spindle, which must be perfectly rigid to ensure accuracy of the sweep, a steady bracket *E* attached to a wall or column is utilised. Courses of bricks are then bedded upon the seating and a circular brick structure built up, the face of the bricks being about $\frac{3}{4}$ in. away from the striking edge of the board, and about the same distance apart from each other, the interstices being filled with loam, the same as would be followed out in masonry. In large heavy cores

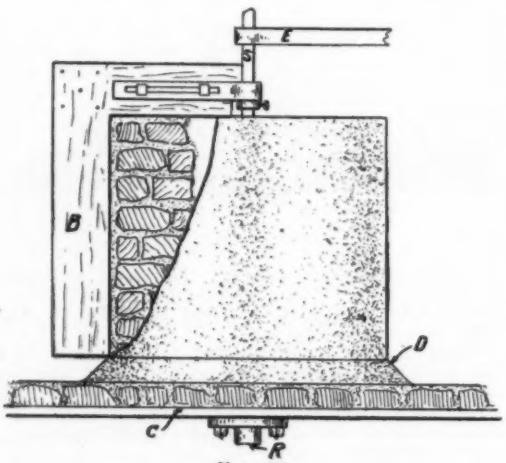


Fig. 25.

further stability is given to the brickwork by inserting every three or four courses binding plates, which are split centrally and kept apart sufficiently to allow freedom for the contracting pressures of the casting. Also to accommodate the contraction, loam bricks are inserted in each built-up course, these latter crushing easily and thus allowing the contraction movements to take place without distorting or fracturing the casting. As a precautionary measure to ensure accuracy of size, a gauge stick, Fig. 26, is commonly used for trying the diameter of the core. This stick at *b* is cut out semi-circularly to fit the spindle and the length *a* is the desired core diameter which measurement allows for contraction.

When cores of this character are required to be set within a mould, as distinct from being made up at their mould position, methods for removal become necessary. The building and striking-up procedure is the same as explained for Fig. 24, but in place of the foundation plate, a bottom plate *B*, Fig. 27, suppports the structure and carries the spindle-run *R* for retaining the spindle *S*, around which the board *A* rotates. Since complete rigidity and stability in these cases are obviously necessary, these essential factors are obtained—especially in the larger cores—by bedding a top plate E upon the upper brick course, the plate being perforated all over its surface for venting purposes. The bottom plate *B* has fixed, as integral parts of it, hooks *C* which carry hook-bolts *D* screwed at one end *G*, and these latter pass through the top plate securing the top and bottom plates by means of a nut screwing upon the hook bolt and binding upon the strap *F*. The number of these bolts obviously depends upon

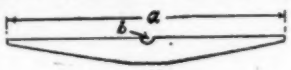


Fig. 26.

the core size. For slinging and lifting purposes internal snugs are formed upon the plates, or chains passed through the vent holes in the plates answer the same purpose.

In the two examples given the cores have been formed by rotating around a spindle a movable board, but for some practices this principle is reversed, the board being made as a fixture and the core structure revolved for forming to shape and size. This method is more especially useful for striking-up with the one board cores of any diameter and length within the striking-board length limit. Fig. 28 illustrates a striking board *H* which is fixed to a wall, its striking edge projecting beyond the wall face. At a distance *a* the spindle *S* is erected, being fitted at one end into a spindle-run *R*, the fitment being of a pivoted point variety. The other end is kept rigid by means of a wall bracket *B* with a split bearing. Fixed to the spindle a spindle-plate *D* is attached by means of a grub screw *E*. This spindle-plate which is strengthened up by means of ribs *r r*, carries the bottom core-plate *F*. The core is built up as in the previous examples, but differs in so far as its shape, size, etc., are obtained by revolving the plate and spindle with the bricked-up loam work, the board *H* remaining stationary.

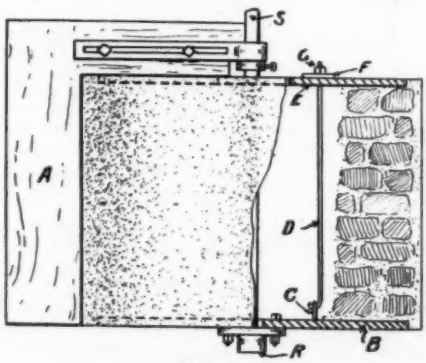


Fig. 27.

As will be readily understood, the distance *a* from the board edge to the spindle centre gives the diameter of the core and, if this be extended greater diameters are easily obtainable. The length of the striking board crosstree *C* is not arbitrary, but usually extends beyond the striking edge of *H*, a distance

which gives a standard radius. To allow for the extension of the steady bracket *B* which must conform to the various diameters required, an extension piece *A* (see detail), which contains the bearing for the spindle *S*, is made movable upon the bracket, its position being fixed by means of bolts passing through both bracket and extension end. To allow for various sized spindles the bearing portion is bushed with wood as shown at *c*. In the example illustrated the extension piece at the bearing centre is shown out of alignment with the bracket face, as if it be assumed that the bracket is fixed at a wall turn—the most convenient place as a rule—allowance must be given for bringing the centre line *x* of the bearing in alignment with the striking edge of the board.

In the examples of these struck-up cores, plain cylindrical forms only have been chosen, but it will be readily understood that a cylindrical core being in its length of varying diameters can by these methods be as easily formed, the cut shape of the striking-board edge being in section the same as the core profile.

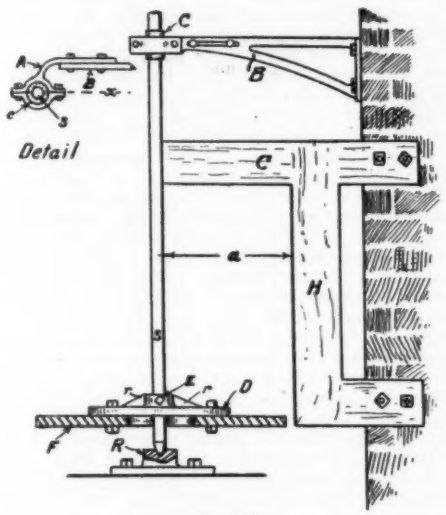


FIG. 28.

When dry-sand cores are preferred to or are more convenient than loam cores, and the making up of a box as Fig. 20 is out of the question, the cores are conveniently and economically formed by means of skeleton boxes, which are guides for obtaining shape, definition, and size. In Fig. 29 the skeleton box for forming one half of a circular core is shown. The end pieces *A A* being cut to the required diameter are fixed to side pieces *B B*, the intervening space between the end pieces giving the core length. A cross-bar *C* prevents the ends being forced out when the core is being rammed up. The ramming is done upon a centrally placed grid which latter projects at the ends for binding the halves together for the complete circular core, and for these grid projections the end plates are cut out as at *d d*. The make-up of these cores is in every respect the same as explained for Fig. 19, differing only in that the circular contour is obtained by means of a straight-edge working around the ends of the end plates *A A*, striking the rammed-up sand to shape. Many applications of this practice are easily apparent, but further distinct examples will be dealt with later.

Metal boxes for forming circular cores range from tubing to specially-manufactured articles, and in respect of the former the tubings used range from ¼ to 6 in. diameters. Excellent cores are made by their means, but in the smaller diameters no great length is obtainable owing to fractures occurring during the rapping necessary for their removal. A

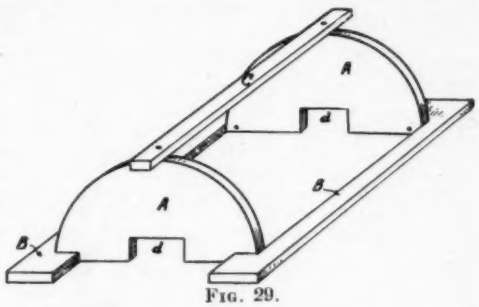


FIG. 29.

specially-prepared form of metal box is shown in Fig. 30, which is made up with flanges registered together as shown. For keeping the half boxes together a boss *A*, upon each flange, receives a cotter pin which prevents lateral movement during ramming of the core. In many instances similar bosses

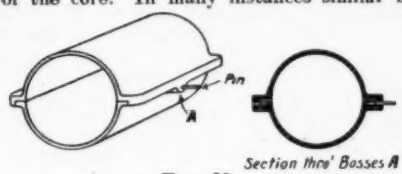


FIG. 30.

are placed at each end, and where long cores are required this becomes necessary to prevent the sides splaying. Alternatively circular bands for this purpose are utilised in a manner similar to those explained for the box, Fig. 6.

THE WORK OF A FEW RARE MINDS.—In his presidential address to the British Association, delivered at Sydney, Professor Bateson applied the analysis of the laws of descent to Man, and showed how nations of the future must regulate the growth of life and death of their populations according to biological laws and necessities. Annul the work of a few hundreds of men, he said, and on what plane of civilisation should we be. We should not have advanced beyond the mediæval stage, without printing, chemistry, steam, electricity, or surgery worthy of the name. These things were the contributions of a few excessively rare minds. The true pioneer, the Newton, the Pasteur, was inconceivably rare. But for a few thousands of inventive geniuses, we should be still in the Palæolithic era.

A CENTRAL TRANSPORT EXCHANGE.—A large number of firms are at the present moment in difficulties owing to their horses or motor vehicles having been requisitioned for military service. Many others find their business so far disorganised as to make it impossible for them to make good use of their vehicles or horses. The Imperial Motor Transport Council has opened at 173, Fleet Street, London, E.C., a Central Transport Exchange for the purpose of bringing those who are short of delivery facilities into touch with those who are short of work for their vehicles for the time being. All enquiries should be addressed to Horace Wyatt, Hon. Sec., Imperial Motor Transport Council, at the above address.

Reclaiming Waste Foundry Sand.

The results of experiments at Detroit (U.S.A.), regarding the recovery of waste foundry sand were recently published in "The Iron Age," from which we extract the following notes :—

A co-operative arrangement was made in accordance with which a number of manufacturers of equipment loaned the necessary machinery and a group of foundrymen defrayed the expenses of the tests. An experimental plant was put down in connection with the laboratory of the H. M. Lane Company, Detroit, and among the machinery supplied by various firms were a paddle-type batch mixer, a hammer crusher for crushing old cores, a roll blending machine for re-bonding sand, a centrifugal mill for disintegrating sand, a dust arrester, a blower, two pan-type roller mills (one was a small experimental mill and the other a three-foot mill), an Osborn washing barrel, and a Dorr washer. Later some slight changes were made in this during the progress of the tests to adapt it to the work. Apparatus was also got out under the supervision of Mr. H. M. Lane, which included a hydraulic classifier, a dry-cleaning machine and a system of elevators, shutes, spouts, etc., for handling the material.

The results of the tests may be stated briefly as follows:—The use that can be made of foundry sand depends upon the character of the original sand used, the character of the binder used, and the style of work that is being turned out. In steel foundries where silica sand is employed, a good recovery can be had by either the wet or dry process. However, with sand from some foundries, the practice had to be varied slightly in accordance with the condition in which the sand left the casting cleaning floor.

The dry-cleaning process takes less plant installation, but more power for its operation. The cost per ton, however, is less in the wet process, as far as the cleaning is concerned, but where the sand has to be used again at once it is necessary to install drying machinery, which increases the cost per ton and thus of operation to such an extent that in most cases there is very little choice either as to original cost or cost of operation between the wet and dry processes. The governing features are local conditions, the character of the sand as it leaves the foundry and, to some extent, the character of the original silica sand used.

The universal opinion expressed by all the steel foundries for whom testing has been done is that the wet-cleaned sand is fully as good as new silica sand and that for some work the dry-cleaned sand is almost as good as new silica sand.

As regards the grey-iron foundry, an entirely different set of conditions is found. Where a very coarse gravel or sand is employed in making large cores with pitch compound or flour, the dry-cleaning process removes sufficient of the fine material from the sand and returns a product which is just as efficient in making cores as the original bank sand. This is also true where glutrin is used as a core binder, provided some clay-wash or moulding sand be used in the mixture.

For oil-sand cores made from fine sand, in cases where no sea-coal or coke dust is used, a number of grey-iron foundries have reported excellent results with wet-cleaned sand and some have had good results from the dry-cleaned sand, the conditions depending more or less on the character of the original sand. For pitch-compound cores or dextrin cores for automobile work, the dry-cleaning process gives excellent results.

Where very fine sands are employed, neither the dry nor wet process removes the carbon sufficiently to give a high binding ratio for oil-sand cores. For brass or aluminium work with resin, dextrin or flour as a binder, the dry-cleaning process returns an excellent product.

In all the experiments the sand coming from the gangway and cleaning room was, as a general rule, put through the machine together regardless of whether it was moulding or core sand.

A number of experiments were made in which the cleaned sand was made into moulding sand. For foundries where a rather fine grade of core sand is used, all of the material from the cleaning room and gangways was dry-cleaned and then re-bonded with clay, the bond being rolled into the material with a roll blending machine. In the first experiment considerable difficulty was encountered in getting a suitable clay, but a good many samples were made which gave excellent results on the sand heap, and it is undoubtedly true that in the case of many foundries the waste product can be utilised to better advantage as moulding sand than in any other way. This also opens up a possibility of making a mixture of cleaned sand and local bank sand bonded with clay for use as a moulding sand.

The apparatus for either the dry or wet process of cleaning is not very expensive. For most classes of work it has been found possible to design a simple machine for crushing up old cores and re-using the material which they contain. The credit side of an account is composed of two items, first, the cost of new sand, and second, the expense involved in disposing of old sand. In the majority of cases sand can be cleaned for less than it can be taken away from the plant and delivered to the dump, and this means that the sand is cleaned for nothing or for a very few pence per ton and is just as efficient as newly purchased sand. In fact, the cleaning of the sand removes the pebbles which have been reduced to dust owing to exposure to heat.

The tests indicate that each plant will have to be designed to fit the special foundry requirements encountered in the different plants, but that once these conditions have been taken into consideration, good returns can be expected from sand cleaning. There are a few types of cores the sand from which is not worth cleaning. In some parts of America 50 to 75 per cent. of the material used is limestone pebbles. This material cannot be cleaned satisfactorily and it is probable that some other local types of sand may give trouble. In a plant where oil-sand cores are being made it will frequently be found advantageous to subject local bank sand to washing so as to remove the loam and reduce the percentage of oil necessary to make good cores.

The magnitude of the waste-sand problem is not appreciated by most foundrymen, nor is the advantage in conserving the core- and moulding-sand resources. Of the waste from some plants, it is claimed by Mr. Lane, 80 to 92 per cent. can usually be recovered and returned to the foundryman in a condition in which it is just as efficient as new sand. Scarcely any foundries are too small to consider the problem, and no plant which does much core work and melts over 12 or 15 tons per day can afford to ignore it.

Fuel Possibilities in Steel-Making.*

By William Whigham†

For the purposes of this discussion all fuels may primarily be divided into two groups. Group I comprises those fuels which come to the steel-maker as a component part of the metals with which he works, as for instance, the carbon, silicon, manganese and sulphur contents of the pig-iron. They are of great importance in the Bessemer process, furnishing as they do the sole fuel used in this branch of steel-making. One ton of representative Bessemer iron contains about the following:—

Element.	Contents in percentage and weight.		Heat value per lb.		Total heat value in ton of Bessemer iron.
				When burned	
	Per cent.	Lbs.	B.T.U.		B.T.U.
Iron	93.67	2,098.20	—	—	—
Silicon	1.45	32.48	12,600	SiO_2	409,248
Carbon	4.00	89.60	14,500	CO_2	1,299,200
Manganese ..	0.75	16.80	2,975	MnO	49,980
Sulphur	0.04	0.90	—	—	—
Phosphorus ..	0.09	2.02	—	—	—
Totals	100.00	2,240.00			1,758,428

As the sulphur and phosphorus are not oxidised to any extent in the Bessemer process, no heat value has been assigned them. It will be seen from the above table that the heat equivalent for oxidation of the entire quantity of silicon, carbon and manganese amounts to only about 1,750,000 B.T.U. per gross ton of iron blown, or, say, 2,000,000 B.T.U. per ton of steel ingots produced. This is equivalent to 148 lbs. of coal having a heat value of 13,500 B.T.U. per lb. It will be seen from this how efficient the Bessemer process is as regards fuel consumption when compared with the open-hearth process using 450 to 600 lbs. of fuel per ton of steel in addition to the fuel content of the iron itself. Were no metallurgical questions involved, the Bessemer process of making steel would probably never have been replaced. The matter of phosphorus elimination, however, has compelled recourse to the open-hearth process where low-phosphorus steel is a consideration.

Group II comprises those fuels which are found in nature as such, and must be adapted through more or less preparation and through the use of extraneous equipment to the purposes of the steel-maker.

Gas from Producers.

On account of its simplicity of operation, the gas producer has up to the present been the means most generally employed for the utilisation of coal in the making of steel in the open-hearth furnace. The uniform passage of the gases of combustion through the upper fuel bed is of prime importance, and therefore the crushing and screening of coal to a uniform size for use in producers is practised where best results are desired. Even with this extra precaution, however, the formation of clinkers and blow-holes throughout the fuel bed is unavoidable unless some method is used of keeping the fuel stirred up. This end was attained at first by hand-poking, and hand-poked producers are still used very generally. The disagreeable character of the work, the expense of the labour involved, and the irregular results obtained, have led to the development of several designs of mechanically-poked producers. Steel-works engineers are not unanimous as to the advantages of one or the other of the two classes of gas producers.

The first cost, based on large installations, will be about the same per open-hearth furnace served, and may be stated in round numbers as £5,000 per furnace in either case, which figure includes four hand-poked or two mechanical producers with all coal and ash-handling equipment complete. The rated capacity of a 10-ft. hand-poked producer is 1,000 lbs. of coal per hour gasified; the average actual capacity is about 800 lbs. per hour, and as a rule about four of these producers are installed for each open-hearth furnace. The rated capacity of the mechanical producer is about 2,000 lbs. of coal per hour and its actual operating capacity in the neighbourhood of 1,600 lbs. per hour. Up to the present time it has been usual to install two mechanical producers per open-hearth furnace; but in some cases five producers have been installed for two furnaces, and it has been suggested that the larger furnaces, making 90 tons of steel at a heat, should have three producers each. It can hardly be said that this large producer capacity has been yet justified by results.

A comparison of the cost per ton of coal gasified, including maintenance and repairs as well as direct labour and supplies, for two large plants, shows the following:—

	s.	d
Cost to gasify a ton of coal, hand-poked equipment	3	2
Cost to gasify a ton of coal, mechanical equipment	1	10
Difference in favour of mechanical installation	1	4

This difference is practically all in the direct labour, as will be seen from the figures below, taken from the same cost sheets.

	s.	d
Direct labour cost to gasify a ton of coal, hand-poked equipment	2	0
Direct labour cost to gasify a ton of coal, mechanical equipment	0	10
Difference in favour of mechanical equipment	1	2

These figures indicate nearly two and one-half times as much labour for the hand-poked as for the mechanical installation, and the whole disadvantage of this excess labour is not indicated by the extra cost. The difficulty at times in securing labour for this purpose is an important element in the decision.

Both types of producer will deliver to the furnace, either in the form of sensible heat or heat of combustion, 85 to 90 per cent. of the total heat in the coal received by them. Average combined producer and furnace practice will show about 550 lbs. of coal to the ton of steel, or 7,425,000 B.T.U., based on 13,500 B.T.U. per lb. of fuel.

The conclusion of the writer from the above data is that the mechanical producer should be used in all large installations. It would appear also—from the fact that the mechanical producer has been perfected to an extent where it requires less than one-half the labour for the older type, and, as stated above, shows from 85 to 90 per cent. efficiency as a gas-making apparatus—that radical improvements in its operation are hardly to be expected.

* Abstract of Paper read before the American Iron and Steel Institute.

† Carnegie Steel Company.

Use of By-Products.

The by-products of coal, such as tar and coke-oven gas, present greater opportunities for advancement in fuel efficiency, but have their limitations on account of quantity available. Wherever tar can be obtained in sufficient quantities, its use has been attended with considerable success. Practice in burning tar as a fuel for steel-making purposes shows that 30 to 35 gallons of tar to the ton of steel is easily attainable, and as each gallon contains on an average about 160,000 B.T.U., the total heat in the fuel required to make a ton of steel with tar is about 5,200,000 B.T.U. as compared with 7,425,000 in the case of average producer practice, or about 70 per cent. This is partially accounted for by the fact that the radiation and other producer losses in the case of coal are not present where tar is used. The figures given above, viz., 30 to 35 gallons of tar per ton of steel, were obtained on a 40-ton furnace and represent by no means the economy which might be looked for on a larger furnace. The method of burning tar is to heat it by steam coils to a point at which it will readily flow, and inject it in an atomised condition through the bulkhead wall of the furnace. Many types of burners have been tried, but nothing better has been found than the simple device consisting of a tar tube inside a tube through which the atomising air is blown, both tubes being drawn to a relatively small orifice at their delivery ends. The pressure of air used for atomising is about 80 lbs.

The cost of installation, including tar tanks, pumps, air compressors, etc., is small, being in the neighbourhood of £300 to £400 per furnace. As to the possibilities of tar as a fuel for steel-making, its limitations are, as stated above, in quantity rather than in any other direction. The uniformity and degree of heat attainable are all that could be expected by the steel-maker; but, in view of its comparatively limited production and use in many other directions, it is hardly likely that it will attain any great prominence as a steel-making fuel. Experiments with by-product coke-oven gas for steel-making have been few.

Use of Pulverised Coal.

One of the most promising methods of using coal, both as to the low first cost of equipment and economy in fuel consumption expected from the process, is in the pulverised condition. The principal points to be taken care of, as seen at the present time, are (1) a thorough drying of the coal, (2) pulverising to a degree of fineness which will permit 90 per cent. of the fuel to pass through a 200-mesh sieve, and (3) its injection into the furnace in a uniform stream. The high flame temperature possible with pulverised coal properly burned has suggested that the regenerators in the open-hearth furnace might be replaced entirely with waste-heat boilers, which are of course a much more efficient means of reclaiming waste heat than firebrick used as renegerators. In any event, the use of coal in this way, which injects its entire ash content into the open-hearth furnace, and a large part of it into the passages and chequers beyond the furnace, would require a modified design of regenerator. On account of the recent adoption of pulverised coal in steel-making, this detail has not been thoroughly worked out.

Crude Mineral Oil.

Reference to crude mineral oil as a fuel is mainly historical as applied to the making of steel as, on account of the present high cost, it is hardly available for this purpose. It was never used in very considerable quantities, and those works which have used it have been compelled to adopt other fuels. The method of burning it was to atomise it in a burner let through the bulkhead of the furnace in much the same manner as coal tar is used. The consumption was about 45 to 50 gallons, or 5,826,600 to 6,474,000 B.T.U. per ton of steel.

Furnace Construction.

Up to this point nothing has been said about the possibilities of better furnace design in order that fuels may be used more efficiently in the furnace Realising the lack of specific information in this respect, a thorough test has been carried out on a 50 ton furnace using natural gas, the test having been made on a furnace using this fuel on account of the ease with which the fuel could be measured and the avoidance of inaccuracy through having to take into consideration fuel losses external to the furnace, as is the case in the use of producer gas.

Beginning with September 27, 1911, accurate measurements were taken of the quantities and temperature entering into the making of 469 heats, occupying a total of 233 days and 2.78 hours. The results averaged for the 469 heats are given in Table I. and show that 12.95 per cent. of the total heat available was found in the steel at tapping time; 1.79 per cent. was in the tapping slag; 1.23 per cent. in the pit slag; 1.57 per cent. and 0.97 per cent. were used in reducing the ore and decomposing the limestone respectively; 30.00 per cent. was absorbed and returned to the furnace by the regenerators; 32.02 per cent. was carried up the stack, leaving 19.47 per cent. for radiation, conduction and unaccounted for. The thermal efficiency of the furnace and regenerators combined, based on the ratio of the first six items enumerated above to the total heat supplied, is shown to be 48.5 per cent. The thermal efficiency of the regenerators is shown to be 38.3 per cent. measured by the ratio of the heat delivered to the incoming air to the total heat in the waste gases leaving the bridge wall. An examination of these figures indicates that there are two items which can be controlled by design and operation. They are radiation and conduction losses, which vary greatly with the con-

TABLE I.—*Heat Balance as Determined from the Average of 469 Open-Hearth Heats from the same Furnace. (Average tons of steel per heat,* 53.6.)

From	B.T.U. per heat.	B.T.U. per ton.	Per cent.
Total heat received,* with source.			
1. Heat of combustion, natural gas	307,707,489	5,740,800	53.91
2. Heat carried in by regenerated air†	171,153,544	3,193,200	30.00
3. Heat of oxidation of bath	59,652,554	1,112,900	10.45
4. Sensible heat of hot metal charge	30,204,480	563,500	5.28
5. Heat of formation of slag	1,938,792	36,200	0.34
6. Sensible heat in natural gas	108,719	2,000	0.02
Totals	570,765,578	10,648,600	100.00
Distribution of heat.*			
To	B.T.U. per heat.	B.T.U. per ton.	Per cent.
1. Heat in steel at tapping time	73,942,900	1,379,500	12.95
2. Returned to furnace by regenerators†	171,153,544	3,193,200	30.00
3. Sensible heat in tapping slag	10,259,083	191,400	1.79
4. Sensible heat in pit slag	7,017,958	130,900	1.23
5. Reduction of ore	8,969,180	167,300	1.57
6. Decomposition of limestone	5,544,694	103,500	0.97
7. Waste gases entering stack	182,776,632	3,410,000	32.02
8. Radiation, conduction and unaccounted for	111,101,587	2,072,800	19.47
Totals	570,765,578	10,648,600	100.00

Thermal efficiency of furnace, including regenerators = Items 1 to 6, inclusive, in distribution above ÷ total heat = 48.5 per cent.

Thermal efficiency of regenerators = B.T.U. returned to furnace by regenerators ÷ B.T.U. in waste gases at bridge wall = 171,153,544 ÷ 446,516,724 = 38.3 per cent.

* All heat values calculated above 62 deg. F.

† "Regenerators" include all passages and chequer-work between bridge wall and stack.

struction of the furnace. It would appear from the construction of a great many open-hearth furnaces that a large amount of heat might be saved by thicker and better walls, particularly around the bulkheads and ends of the furnace.

Stack Losses.

The following shows the average analyses by volume of the stack gases from 469 heats:—

CO_2, per cent.	5.31
O_2, per cent.	13.05
CO, per cent.	00.00
N_2, per cent.	81.64
	100.00

A study of this analysis will show that there is about two and one-half times as much air present in the stack as is needed theoretically for combustion of the gas. This large excess of air reduces the flame temperature, and the water carried into the furnace as moisture in the air also has a material effect on the temperature. The average flame temperature with the 150 per cent. excess air was 3,074 deg. By approaching the theoretical amount of air required higher temperatures might be obtained, thereby reducing the volume of waste gases and the time required per heat, and so leading to fuel economy. To reduce stack losses the temperature and weight per hour of the waste gases must be reduced, and to do this it is absolutely essential to have control of the air supply. This control cannot be had by throttling the air at the remotest source of supply, viz., the air inlet valves, as the furnace is not air-tight and the stack simply supplies its demand through the slag hole, around the door frames, and other openings, this leakage not only entering without pre-heating but coming in where least needed for combustion. Theoretically, one cubic foot of gas requires 9.2 cub. ft. of air for complete combustion. The air meters measured in this experiment on an average 13 cub. ft. of air through the chequers for every foot of gas consumed, and the leakage through the furnace was 10 cub. ft. or 77 per cent. excess above that measured.

The heating and cooling effects of the waste gases and air as measured at the furnace or "hot" end and at the stack or "cool" end of the regenerator chamber show that, for 20-min. reversals, the gas at the hot end of the regenerator works between 1,675 deg. Fah. at the beginning of the heating period and 2,125 deg. Fah. after the gases have been passing through the regenerators for 20 min., while at the cold end of the chamber the gases have a temperature of 645 deg. at the beginning of the heating period and rise to 1,415 deg. at the end of the 20-min. period. The point of greatest significance is that after the gases have passed for 10 min., further absorption by the chequers is obtained only at the expense of comparatively high stack temperatures. The conclusion in general is that reversals should be of as short an interval as possible consistent with the maintenance of temperatures sufficient for the purposes of the furnace. As a matter of fact reversals on this particular furnace have been cut down to 15 min., with an increase in fuel economy and reduced repairs on the furnace. The temperatures not working over so great a range lead to less wear and tear on the brickwork of the furnace.

One other method of recovering the heat in the stack gases offers itself to the engineer, and that is the use of waste-heat boilers beyond the chequers; this method is being used with a high degree of success. One of its disadvantages is the large capacity of boiler required for a given recovery on account of the comparatively low temperatures of the gases. A 75-ton open-hearth furnace must be fitted with a 400-h.p. boiler in order that 200 to 250 h.p. of steam may be developed. Notwithstanding this and other disadvantages, an installation of open-hearth waste-heat boilers will give a good return on the investment, particularly in localities where fuel prices are high.

Recent developments in the duplex process have shown a reported fuel consumption of 150 to 180 lbs. of coal per ton of steel, which might be expected from the high thermal efficiency of the Bessemer part of the process, and it is highly probable that, if these results are borne out by continued practice, the most economical consumption in steel-making will be obtained by the use of this process, in which the open-hearth portion will be carried on with the most economical method of burning fuels as outlined above, viz., some form of fuel consumption in which the entire combustion takes place within the furnace walls, supplemented by furnace construction which will permit of a minimum radiation, large chequer chambers with comparatively frequent reversals, and waste-heat boilers between the chequer chambers and the stack.

British Foundrymen's Association.

Awards by Prize Committee.

The Awards Committee of the British Foundrymen's Association have recommended the following papers for diplomas:—

"Modern Steel Foundry Practice"; by J. Peers (Sheffield Branch).

"Malleable Castings"; by H. Ford (Newcastle Branch).

"The Annealing of Steel Castings"; by A. T. Adam (Scottish Branch).

"Reducing Pattern Costs"; by D. Gordon (London Branch).

"Heat Treatment of Cast Iron"; by R. Carrick (Halifax Branch).

"Moulding Sands and Facings," by D. McQueen (Scottish Branch) was highly commended.

The Awards Committee consider that the character of the papers was very satisfactory in view of the fact that this was the first year of the competition. The object of the competition, i.e., the bringing out of useful papers and stimulating the desire for research shows promise of being fulfilled.

The Branch Secretaries are requested when fixing up Programmes to aim at getting Papers that can enter the competition, and obtain the MSS. of same, which must be submitted to the General Secretary not later than May 31.

London Branch.

At a general meeting of the London Branch held on Saturday, August 29, the election of officers for the forthcoming session took place. Mr. J. Ellis (Junior Vice-President of the Parent Association) was elected Branch President for a second year. Owing to the retirement of Mr. R. Woods from the Vice-Presidency, Messrs. A. Willis and A. R. Bartlett were elected vice-presidents. Messrs. Barker, Aitken and Hall were elected to the Branch Council, and Messrs. W. H. Aston and T. W. Aitken were elected as representatives on the Parent Council.

The meeting learnt with regret that Mr. T. Murphy, to whose initiative and hard work the London Branch owes its existence, was compelled on account of business to relinquish the post of Honorary Secretary. Mr. Alexander Hayes, 165, Strand, London, W.C., was elected to the position *pro. tem.*; with Mr. David Gordon L.C.C. School of Engineering, Poplar, E., as assistant.

Electric-Furnace Steel Castings.*

By C. A. Hansen.

During the summer of 1911 a three-phase arc furnace, having a nominal capacity of 2 tons per charge, was installed in the new foundry of the Treadwell Engineering Company, Easton, Pa., U.S.A. The cost of melted metal from this furnace has been found to be somewhat less than one-half that of the old crucible-furnace plant using oil at 1¼d. per gallon.

Electric steel castings are usually made with lower carbons than is possible from even clay-lined crucibles. In the latter it is possible to melt 0.20-carbon steel, but it is not possible to run the 0.20-carbon product regularly into light-section castings. As a result, 0.30 to 0.40-carbon castings are the usual output of the crucible-steel foundry, and all castings which require machining must be annealed. With the electric furnace the furnace-maintenance costs increase rapidly as the carbon content of the product is brought down, and, quite contrary to current opinion, it is not economical to turn out 0.10-carbon steel castings, although it is quite possible to do so. It is, however, economically practicable to turn out 0.20 carbon castings, and such castings can be machined easily without annealing. There is little question that all castings, whether 0.20 carbon or 0.30 carbon, can be improved by annealing.

According to current opinion, also, the advantages of the electric furnace follow largely from the fact that such a furnace can work up any sort of a charge. While this may often be true, it is not well to base estimates of the cost of molten electric-furnace steel upon the usual published furnacing costs and upon the local prices of scrap and similar materials.

Many have suggested charging molten cupola metal directly into the electric furnace for refining. In several such cases of which I know, the power consumption per ton of output was greater for the cupola-metal charge than for the cold-scrap charge; the original cost of the cupola metal was in the neighbourhood of 75s. per ton, as compared with 50s. per ton for the regular cold charge, and the cost of furnacing was likewise higher for the cupola-metal charge. The economy incident to heating the furnace with auxiliary fuel-burning apparatus may interest those who charge molten metal into electric furnaces, but the interest attaches rather to the prevention of skulled furnace bottoms than to a direct saving in electric energy. Heating the furnace and charge to a good red heat by means of oil burners (with oil 1¼d. per gallon) increased the cost 4s. 2d. per ton over the regular practice of all-electric heating. Keeping the furnace hot over night by means of either oil or electric energy was found not to materially decrease maintenance costs, and it did increase the cost of production. These items above refer to power supply at approximately ½d. per kw.-hour.

Much stress has been laid on the economy attaching to continuous operation of the electric furnace as compared with day-shift operation. So far as costs for the molten steel go, it is true that continuous operation means 10 to 15 per cent. saving over intermittent operation. Very little has, however, been said regarding the relative efficiencies of day and night work in the other departments of the foundry, nor has it been well impressed upon the mind of the average investigator of electric-steel problems that one can easily lose many times the 10 to 15 per cent. saving in molten-metal costs in the decreased efficiency of the night shifts on the moulding floor.

Claims are being made that 10 to 12 heats from cold scrap can be taken from one electric furnace in 24 hours. Possibly they can, but the furnace will have to be rebuilt at least three times each week.

These and other considerations have led to the practice, now established at Easton, of operating the foundry on day shift only, charging a good quality of steel scrap, enough pig and ore being added to keep the charge off the furnace bottom, and casting steel of around 0.20 per cent. carbon, unless otherwise specified. The furnace plant has been operated on a one-heat-per-day basis, requiring 7 to 7½ hours to turn out its charge from the cold furnace. Power consumption at furnace transformer primary terminals has, in that case, averaged 1,050 kw.-hour per 2,000 lbs. steel in the ladle.

The furnace has been operated also on a two-heat-per-day and three-heat-per-day basis, when business conditions warranted. The second and third heats, having the advantage of being started off in a hot furnace, are finished in 4½ hours, at a current consumption of 630 to 640 kw.-hour per ton. Even with the three heats per day, no steel is poured outside of the regular day shift. Two men start the furnace shortly after midnight, and steel is poured at 7.15 a.m., 11.45 a.m., and at 4.30 p.m. The uncertainties attaching to pouring on schedule time are not as great as they are with either open-hearth or crucible furnaces.

The load curve for the furnace here considered is smoother and of higher power-factor than the load of similar magnitude used in the shops of the Treadwell Company, where the products of the steel and iron foundries are machined. It seems a pity that the electric steel furnace was not developed by people familiar with the load characteristics of modern machine tools, rolling mills, street railways, etc. Central stations are quite familiar with these loads, but they are not familiar with the arc furnace, so when we dwell upon the bad features of the arc-furnace load we can scarcely blame the central station for supposing the load-curve of the latter to be a really bad one.

The following data concerns the above-mentioned furnace installed by the Treadwell Company:—

Average number of heats per week	15
Average weight per heat, pounds	4,600
Average power consumption per 2,000 lbs., kw.-hr.	900
Average repair costs per 2,000 lbs.	10s. 6d.
Average electrode costs per 2,000 lbs.	10s. 6d.
Average weight castings made, pounds	9
Ratio of cleaned castings, risers, etc., to charged weight, per cent.	92–95
Ratio of finished castings to charged weight, approximate per cent.	60

The furnace lining is repaired after 35 heats.

Extremely hot steels are poured, and this fact is reflected in the high maintenance costs and in a rather high power-consumption. A similar furnace, of which the writer has accurate records, shows costs as follows:—

Power consumption per 2,000 lbs. kw.-hr. ..	725
Repair costs per 2,000 lbs.	5s. 5d.
Electrode cost per 2,000 lbs.	9s. 0d.

The latter furnace is pouring somewhat colder metal into castings of 15 lbs. average weight, and repairs to the furnace lining are made after 8 to 10 weeks' operation on the same basis of 15 heats per week.

* Abstract of Paper read before the American Electrochemical Society, New York.

Pattern-making for a Double-Ported Slide Valve.

By Chas. A. Otto.

One of the most interesting as well as instructive jobs in a marine patternshop is the making of a pattern and core-boxes for a double-ported slide valve. The pattern in itself is not difficult to the workman having some knowledge of moulding as well as pattern-making, but the intricacies of the cores require a large amount of such knowledge and ingenuity in the making of suitable core-boxes. The following is one way of making the pattern and core-boxes required.

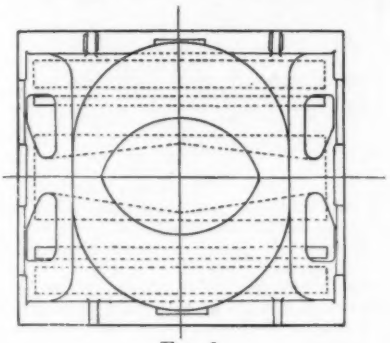


FIG. 1.

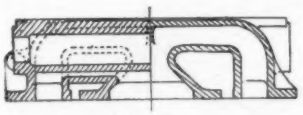


FIG. 2.

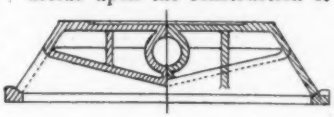


FIG. 3.

The drawings, Figs. 1, 2 and 3, are similar to those which would be given to the pattern-maker for a L.P. slide valve having double portways, and from which he would be required to make the necessary pattern work. Fig. 1 represents the plan, looking on the back, *i.e.*, on the spring facing. Fig. 2 shows two half-sections, the right-hand half being an imaginary view with the thickness of metal taken away, the left-hand section being a representation of the job cut through the centre of the barrel for the valve spindle. Fig. 3 shows two sections also, but at right angles to the latter two sections, the left-hand view being taken through the smallest portway and the other one through the centre of the valve.

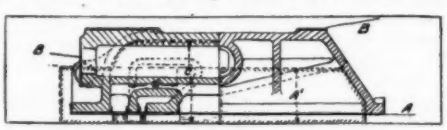


FIG. 4.

It is advisable at the commencement to make a full-sized drawing on a board to simplify the making of the job, to be used afterwards by the moulder for obtaining the thicknesses of metal. A narrow board, a little wider than the depth of the valve, upon which can be drawn two half-sections, is ample for the purpose and practically all dimensions can be shown. Fig. 4 represents the drawing required, comprising the left half section of Fig. 2 and the right half-section of Fig. 1. The drawing should be made to the finished sizes first, and those parts which are required to be machined should be afterwards increased by about $\frac{3}{16}$ in. or $\frac{1}{4}$ in.; this method

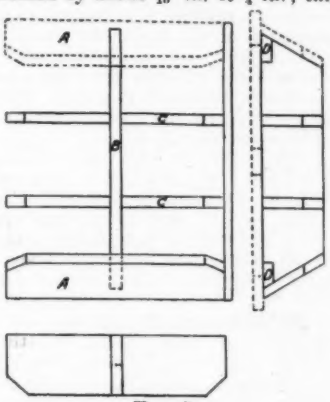


FIG. 5.

prevents complications in the process of marking out.

When this drawing is completed the workman will decide upon the construction of the pattern, but in doing so he must also take into consideration the method of moulding it. Almost invariably in valves of this kind the mould is divided at A and B. The face of the valve, requiring very good metal, is cast "down," and the pressure of the metal above it ensures a sound finish on the casting.

The body of the pattern is "boxed up," and the

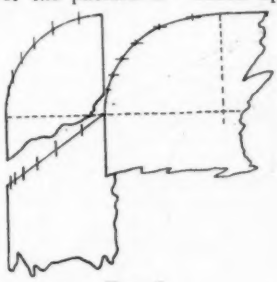


FIG. 6.

flange is framed together, which makes the job light and strong as well as reducing to a minimum the expansion and shrinkage of the timber. Commencing, the flanges are framed together, having a tie-piece through the centre, 5½ in. or 6 in. being generally a suitable width for this purpose. Next, three bearers or grounds are cut out, two being canted to support the lagging for that part of the body which is curved, the other being bevelled at

both ends; these grounds may be 1½ in. to 2 in. in thickness, and are cut to allow for 1-in. or 1½-in. lagging. They are half-lapped, as shown in Fig. 5, and screwed to the framed flange from the face side. Two pieces of 1½-in. timber bevelled to fit against the ends of the ground B and canted so as to be in line with C C, are cut out and screwed to B and to the flange so that the outside size will be just correct to the drawing. The next procedure is to attach two side pieces of lagging from the flange to the beginning of the cants and fit in from corner pieces marked D on Fig. 5; these are to be fastened to the flange to act as a safeguard against the possible alteration of the body with the flange. The whole of the lagging can now be firmly attached, taking care to leave as little for final trimming as possible, as much time and energy is often wasted in leaving about $\frac{1}{16}$ in. and sometimes as much as $\frac{1}{8}$ in. for final cleaning up.

Forming the curve on each side of the body is practically all the planing which is required. There are two ways of marking the bevelled ends for this purpose; they can be marked geometrically in a manner shown by Fig. 6, but each would of necessity be marked off separately, causing a waste of time. The most practical way is to mark the true radius on a piece of wood and cut it out neatly with a band

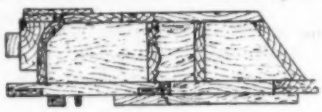


Fig. 7.

saw, afterwards cutting it to suit the bevel on the end of the body; lay this on the work and mark off.

When the main body has been planed to the required size, it is ready to receive the smaller pieces, which are made loose for convenience. The first to be attached would be the back facing, which can be made in two or four pieces; in the present instance four are advisable. These are screwed to the body and that part which overlaps thickened up by sustaining pieces the required thickness underneath and marking around the projecting facing; these pieces do not require to be made to fit the radius on the body, it being necessary to simply make the inside edge square, as shown in Fig. 7. Two bosses for the ends, sufficiently thick to allow for fitting, are next cut out, if possible using a sand-papering disc to make them the necessary

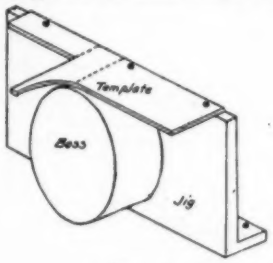


Fig. 8.

diameter and allowing about ½-in. taper. These are made to fit the body directly from the band saw by screwing them to a jig similar to that shown by Fig. 8.

Two prints having a contour equal to the required holes and about 2 in. in length are attached to the bosses and the whole secured to the body in such a manner as to be easily detachable. The remaining details are screwed on before turning the job. The prints are then screwed on to the face of the pattern, being about 1 in. in thickness and slightly tapered to allow for easy withdrawal from the sand;

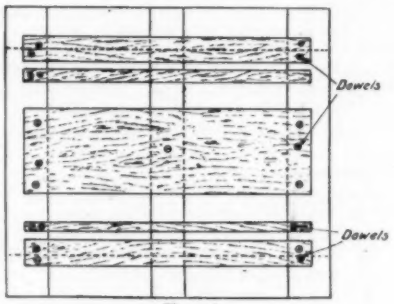


Fig. 9.

a couple of dowels are placed in each print, as shown in Fig. 9, so that when the moulder takes out the screws he may be sure of their relative position being unchanged.

The core-boxes, of which there are usually four, occupy more of the workman's time than the making of the pattern, because of the complicated nature of the internal portion of the casting. The main core is generally made in halves, being severed through the centre of the valve-rod barrel, as represented by the right-hand section on Fig. 4. A method for constructing a box from which these two half-cores can be made separately, is shown by sketches, Figs. 10 and 11. To commence, two ends A A are cut out, the width of these being equal

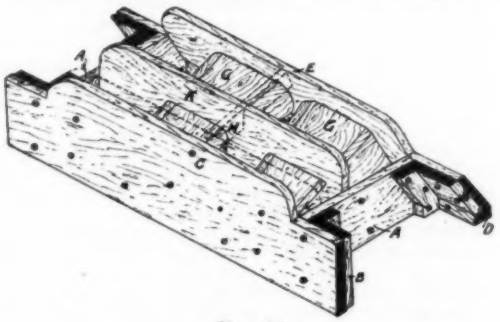


Fig. 10.

to that marked A¹ on the right-hand section of Fig. 4, *i.e.*, from the centre, from which the radius is used to mark the curve on the body of the valve, to the bottom of the prints, the length being from the centre of the valve to the inside contour of the metal, as shown in Fig. 4. Battens are attached to the outside of these pieces and flush with the ends of them. Next, three pieces marked C, D and E are cut out to form the sides of the box. The dimensions are shown in Fig. 4, half of the correct shape being shown on the left-hand section. These sides are lengthened beyond the correct size of the core to accommodate the ends and to strengthen the box. Battens are attached to these also, but on the inside of the pieces, leaving a distance between them equal to the total inside size of the valve, plus the thickness of the ends and battens. The sides are screwed to the ends, using the battens on the latter for a better hold for the screws. The box thus

formed is the outside portion of Figs. 10 and 11. A semi-circular piece is now required to block out of the core the shape of the barrel, a section of which is shown on Fig. 4; this is cut to the inside length of the box and the ends cut to suit the radius, being finished after it has been screwed in its correct position.

Two blocks should next be made, their outside sizes being similar to the outside sizes of the metal enclosing the steamways from the centre outwards. A simple method for constructing them is to box them up parallel in width and equal to the size marked G on Fig. 4, the tapered portions being

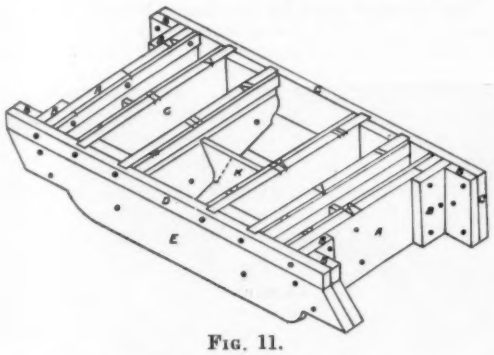


FIG. 11.

shaped and screwed to their proper positions on the block. G G on Figs. 10 and 11 show these blocks in position. (Note:—The sides are made a little longer and corresponding places are notched out from the sides of the core-box so that their correct relationship with each other and with the box as a whole may be retained without any trouble). The three sets of facings are then required; these usually vary in thickness, and the width is generally determined by the amount of machining strip and the depth of the prints, the former being usually from $\frac{3}{4}$ in. to 1 in. in width. These are screwed in their respective places so that they may be readily detached by the moulder. All that now remains to

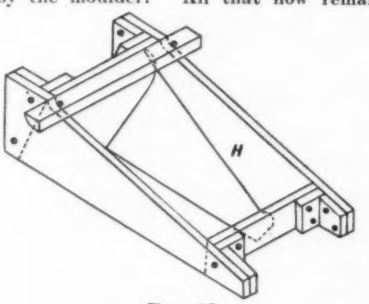


FIG. 12.

finish the main box is the insertion of the strengthening ribs K and M; these may be half lapped together at the centre of K, being made loose fitting with each other. The rib M is parallel and a screw into the ends through the sides C and E will be sufficient to keep it in its place, but the rib K should be made a little longer and inserted into the ends of the box, as shown, and that part which is between the two steamway blocks should be cut, as shown in Fig. 11, so that no difficulty may be experienced by the moulder when stripping the core.

This box will form one half of the main core. To make the other half the box must be reversed, and this should be done before it leaves the pattern shop, so that each part which needs altering may be properly marked to prevent mistakes. A simple method is to cut a number of marks with the tenon saw in

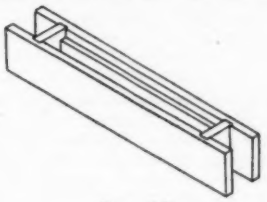


FIG. 13.

a similar manner to that shown in Fig. 11. The facings are the only parts which need altering usually. Fig. 12 is a sketch of the second box which would be necessary for the steamway cores. As in the first case, only half a core may be made at one time. For convenience in moulding the depth of the box is made from the inside thickness of metal around the steamway to the top of the flange. The method of making this box is very similar to the method adopted for the previous one, only in this case the outside portion is made about $\frac{1}{2}$ in. wider than the largest width of the required core and the piece or pieces H are inserted to stop off that part which is not required, forming the tapered side on the core. Two cores would be required out of the box as illustrated; then the pieces H would be taken out and pieces of a similar kind, cut to the opposite hand, attached to the other side of the box for the next two cores.

The third box is represented by Fig. 13, which makes the continuation core for the steamways, cutting through the flange and of a sufficient depth

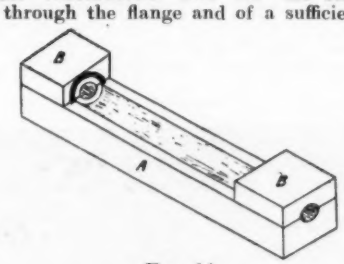


FIG. 14.

to fill up the impressions left by the prints. This box is generally made the full length of the prints on the pattern face. One core would be made out of the box, as shown, and then the steamway opening altered by means of new facings for the next core.

The fourth and last core-box required is that for the opening through the barrel for the valve rod. Sometimes this core is swept up on a horizontal spindle by means of a board having a profiled edge similar to the section shown on the left side of Fig. 4, the ends being rubbed to the desired shape afterwards. Fig. 14 shows a method for making a box for such a core, A being equal in length to the distance between the outside of the prints fixed on the body of the pattern; B, B, being two pieces dowelled to A of a length sufficient to form the shoulder on the core, the top of the circular part of the core being formed with a strickling board having a semi-circular piece cut out and made to slide along the piece A so that the core will be circular between B and B when taken out of the box.

A Study of the Annealing Process for Malleable Castings.*

By Oliver W. Storey.

This article gives the results of experimental work carried out by Mr. E. L. Leasman under the author's direction at the Chemical Engineering Laboratories of the University of Wisconsin. Although these experiments were preliminary in nature as a basis for extended work, interesting results were obtained.

The experimental work was carried out to determine the effect of the following variables upon the annealing process:—(1) Packing materials; (2) temperature of annealing; (3) time of annealing; and (4) rate of cooling. This was undertaken as a metallographic problem. All specimens were studied with the microscope, which showed the structural changes.

In making malleable cast iron, white cast iron is used for the hard castings. This white iron must have an analysis within certain limits to insure proper annealing. It is then annealed at the proper temperature, usually between 750 deg. and 900 deg. C., depending upon the practice, for about 60 hours, after which it cools slowly.

The structure of such a white cast iron is shown in Fig. 1. The two constituents shown are the white cementite and black pearlite, which is an eutectoid of ferrite and cementite. The cementite or iron carbide, Fe_3C, is present in two forms; first, as excess, and second, associated with ferrite as pearlite, After being annealed at the proper temperature and slowly cooled, the interior structure is usually that of Fig. 2, ferrite and temper carbon, with an outer shell that may vary from a pure iron to a high-carbon steel. Fig. 3 is the fracture of a test lug, showing the black heart with an outer bright steel rim.

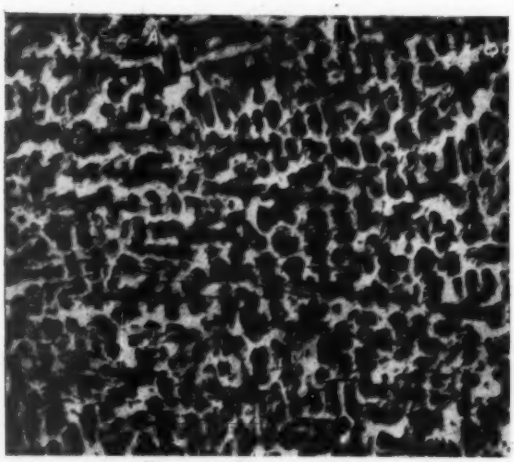


FIG. 1.—MAG. × 100.

It is evident that the formation of the malleable structure of ferrite and temper carbon is due to the breakdown of the iron carbide into its elements, iron and carbon, at the annealing temperature, according to the following equation:—$Fe_3C + heat = 3Fe + C$.

This reaction explains the formation of the black heart, but not the rim structure. A different condition is necessary to produce a pearlite shell than

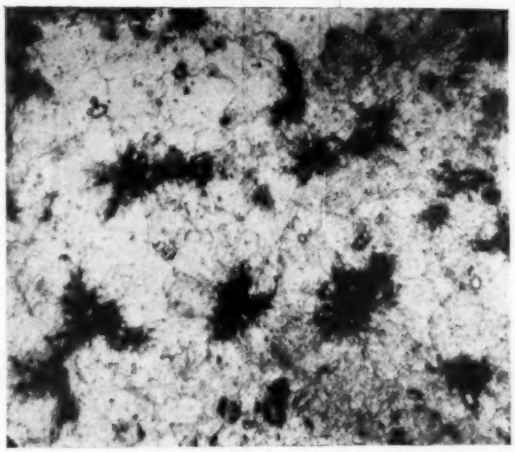


FIG. 2.—MAG. × 100.

to produce one of pure ferrite. Three different rims are shown in Figs. 4, 5, and 6. Fig. 4 is the rim structure of the fracture shown in Fig. 3, and shows a medium-carbon steel area covered by a thin skin of ferrite. Fig. 5 shows an outer rim of nearly pure pearlite, while Fig. 6 shows one of pure ferrite.

The four variables mentioned determine the structure of the casting. The packing materials will affect the rim, while the time and temperature of annealing and rate of cooling will determine the interior structure, with only a minor effect upon the rim.

The white iron used for the experiments was in the shape of test bars ¾ by ¾ by 10 in., with the following analysis:—

Total (combined) carbon	2.60 to 2.70%
Silicon	0.65 „ 0.70%
Sulphur	0.055 „ 0.060%
Phosphorus	0.140%
Manganese	0.27%

Fig. 1 is a micrograph of the white iron used. The structure shows a high percentage of pearlite, owing to the low percentage of carbon, resulting from steel additions to the melt.

The annealing furnaces used for these experiments consisted of two muffles electrically heated by resistance wire. A low-voltage regulating transformer gave absolute temperature control. All thermocouples used were calibrated frequently against a standard platinum, platinum-rhodium couple.

In order to carry on a larger number of experiments in this preliminary work a number of small

* "Metallurgical and Chemical Engineering."

containers were made. Several could be used in the furnace at the same time. These containers were made of 1½ in. pipe, cut long enough to take specimens 2 in. in length. They were then luted with fireclay except where caps and nipples were used. The serious objection to these small containers was that the oxygen of the air usually had access to the specimen.

Effect of Packing Materials.

The first variable to be studied was the packing material. It had been noticed that certain specimens of commercial malleable iron had an enveloping skin of steel (Fig. 5), others pure carbonless iron (Fig. 6), while others showed an intermediate structure (Fig. 4). It was thought that the packing material would determine the structure of the outer shell.

A large number of packing materials were used, including lime, sand, alundum, rolling-mill scale, resistor carbon, manganese dioxide, cement, fine and coarse fire clay, iron oxide, alumina, fine graphite and carborundum. The results obtained by the use of these various materials showed that their physical and chemical constitution influenced the skin structure of the annealed casting. The packing material had no apparent effect upon the interior in the American "black heart" practice.

The chemical composition of the packing material was a factor that partly determined the nature of the outer portion of the annealed casting. With the materials which were stable at the annealing temperature the structure was uniformly a layer of ferrite. With oxidising materials a deep layer of ferrite was formed. It is probable that enough oxygen was liberated to decarburise to a greater depth. With carbon, charcoal, graphite and case-carbonising materials, a skin structure was formed which varied from a low-carbon to a high-carbon steel.

The physical structure of the packing materials also affected the malleable skin structure. Materials which were loose and porous and allowed a free circulation of the air showed a ferrite exterior. Without the oxygen of the air the structure of the exterior portion did not differ from the interior. This was best illustrated by the following experiments.

Brass turnings were used as a packing material in one of the containers. The brass fused at the annealing temperature and completely enclosed the specimen, preventing the oxygen from coming into contact with the exterior of it. Although a normal malleable structure was formed in the other specimens annealed in the same heat, the temper carbon extended to the brass coating which had formed on the specimen.

That the chemical composition of inert packing materials has little effect on the rim structure is evident from samples of commercial iron. Specimens from various plants using mill scale as a packing material showed a rim structure varying from pure ferrite to a high-carbon steel. It is probable that the atmosphere of the furnace and the looseness of the packing rather than the chemical action of the scale determines the rim structure.

The experiments were not carried far enough to determine under what conditions the various degrees of decarburisation could be obtained. Even if results were obtained these could hardly be comparable with those obtained in malleable practice. The atmosphere of the experimental furnace was highly oxidising as compared with that of the commercial furnace. The small containers also allowed a quicker penetration of oxygen than those used in commercial practice. The probable exception was in the use of unusual materials such as carburising mixtures. But with materials such as mill scale, sand, clay, cinders, ashes, etc., the exterior structure depends upon the composition of the atmosphere in the furnace, upon the annealing temperature, the method of packing, and the rate of cooling. The writer recalls one malleable plant where scale is regularly used when the furnaces are running at the normal rate. But when a rush comes anything within reach is used as a packing material, usually ashes and cinders. No difference in structure is apparent between the two malleable products. In another plant brick-dust is replacing scale with no apparent change in structure. Large castings are annealed by merely heating in a muffle, care being taken to prevent excessive oxidation. The structure is the same in all cases, consisting of an exterior layer of ferrite, or pearlite, or both, and an interior of temper carbon and ferrite.

The skin structure, when a neutral atmosphere is used, does not differ from the interior, since the breakdown is the same throughout the specimen. This was shown by the specimen annealed in brass. This indicates that a slightly oxidising action is necessary to secure a steel rim and that either a too highly oxidising or a neutral atmosphere will give a ferrite or a ferrite and a temper-carbon rim, respectively. The rate of cooling also has a slight effect upon the skin structure. A slow rate of cooling tends to result in a ferrite rim. This will be discussed later.

Where a case-carbonising mixture was used as the packing material, the rim resembled the original iron (Fig. 11), since some of the excess cementite remained undecomposed. This structure will also be discussed later.

A peculiar rim is shown in Fig. 12. Here two steely strata are seen with a ferrite structure between them. Only one specimen showed such a structure.

The following conclusions may be drawn :—

(1) The packing material does not influence the interior of "black heart" malleable cast iron.

(2) The ordinary packing materials do not directly affect the skin structure of malleable cast iron.

(3) A loose packing material allowing a free circulation of oxidising gases will result in a carbonless rim.

(4) A slightly oxidising atmosphere will result in a steely rim.

(5) A neutral atmosphere will result in a rim having the same structure as the interior of the iron.

(6) A slow rate of cooling will tend to result in a rim of ferrite.

Effect of Temperature of Annealing.

A number of experiments were made to determine the most effective annealing temperature for iron of the analysis given, where the time of annealing was 50 hours and the cooling to 250 deg. C. took 50 hours.

Experiment No.	Annealing Temperature Deg. C.
4	815°
5	760°
6	700°
7	730°
9	840°
10	790°–800°

The specimens annealed at 700 deg. were too hard to saw, though slightly malleableised.

The specimens annealed at 730 deg. were sawed with difficulty. Upon examination with the microscope the structure had broken down slightly.

The specimens annealed at 760 deg. showed a partial breakdown of the cementite, as shown in Fig. 7.

Specimens annealed in experiments 4 and 10 showed but a partial decomposition of the cementite.

Upon annealing at 840 deg. the carbide was almost entirely broken down (Fig. 8).

In one experiment the temperature was kept at 535 deg. to 650 deg. F. for 120 hours, but these specimens were too hard to saw.

In the first experiments an annealing temperature of 870 deg. to 900 deg. was maintained for 50 hours, and this resulted in a complete breakdown of the cementite. (Fig. 6.)

The effect of the temperature is an important factor. Not only does the time of annealing, but also the quality of the resulting product depend upon the temperature. It is possible to cut down the time of annealing by raising the temperature, but woe befalls those who do it. A poor product results. The lower the temperature of the anneal the better the product. The balance must be found between the increased value of the improved product and the high cost of the longer annealing.

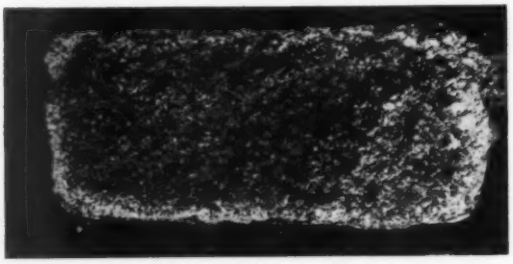


FIG. 3.—MAG. × 2½.

Figs. 2, 6, 7, and 8 are micrographs of structures of malleable iron annealed at varying temperatures. Fig. 7 shows the result of annealing at 760 deg. The micrograph shows areas of cementite in a background of ferrite with a few particles of temper carbon. The dendritic structure of the cementite is visible. This shows that the cementite in the pearlite suffers the first breakdown and that the excess cementite is the last to dissociate. By annealing at 840 deg. the structure of Fig. 8 was obtained. Small particles of undecomposed carbide are still visible though the specimen is composed mainly of ferrite and temper carbon.

Fig. 2 is a micrograph of some commercial iron and shows small areas of cementite. Most commercial malleable cast iron shows such areas, indicating that the annealing has not been entirely completed. In Fig. 6 the structure is entirely of ferrite and temper carbon, indicating that the breakdown at 870 deg. was complete.

The conclusions to be drawn are:—

(1) With an annealing time of 50 hours the white iron furnished required an annealing temperature of 860 deg. to secure a complete breakdown of the cementite.

(2) Annealing at 740 to 760 deg. for 50 hours resulted in a partial breakdown. By continuing the heat to double the above time it is probable that a complete breakdown could have been secured.

(3) No decomposition could be observed in specimens annealed below 670 deg.

Effect of Rates of Cooling from the Annealing Temperature to 250 Deg. C.

In all malleable-iron work one of the most important factors is the rate of cooling. In the annealing the cooling is slow, usually requiring from 40 to 60 hours. If the cooling is too fast a hard, brittle steely structure results.

In this research the result of the different rates of cooling was noticed in the first three experiments. When the rate was slow, that is, the drop from 900 deg. to 670 deg. required 38 hours, the interior of the specimen showed an excellent malleable structure, ferrite and temper carbon (see Fig. 6). When the same drop in temperature required but 22 hours, the resulting interior structure showed ferrite, temper carbon and areas of pearlite (see Fig. 9). When the time occupied but 15 hours, the interior showed pearlite, temper carbon, and a small amount of ferrite (see Fig. 10).

From these data it was evident that the structure of the resulting metal was dependent upon the rate of cooling. It was not only desirable to determine the most suitable rate of cooling, but also to obtain the critical range through which this cooling had to be slowest. The A_1 temperature, 700 deg., was regarded as the critical point. At this point the transformation of austenite into pearlite occurs. The experiments were run so that the critical range was above 670 deg., allowing for a lag of 30 deg.

In experiment No. 11, the first of this series, the furnace burned out and the time of cooling was rapid, requiring 14 hours to drop from 870 deg. to 250 deg. All specimens showed an interior of high-carbon steel and temper carbon similar to that of Fig. 10. In experiments No. 12 to No. 16 the time of cooling from 870 deg. to 750 deg., 750 deg. to 670 deg., and 670 deg. to 250 deg. was varied. From these experiments the conclusion was drawn that the rate of cooling from 670 deg. to 250 deg. had little, if any, influence on the structure.

When the malleable iron made in these experiments was reheated for 10 minutes the carbon did not go into solution below 800 deg. and form a steel with air cooling. A slight amount of carbon went into solution when heated for 1 hour at 800 deg. If the malleable iron was heated at 850 deg. enough carbon went

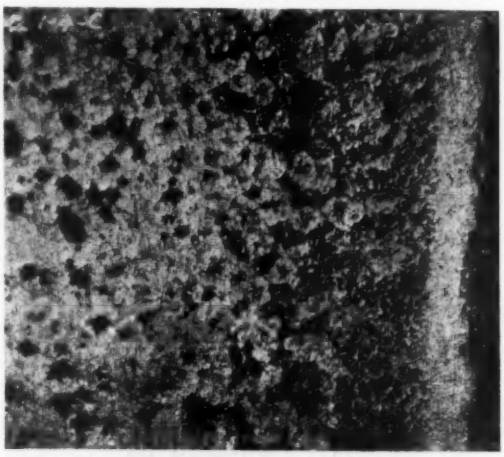


FIG. 4.—MAG. × 30.

into solution in a few minutes to form a high-carbon steel. This experiment showed that the carbon could not precipitate out entirely above 800 deg., and that the critical range was below that temperature.

Specimens which had been heated to 900 deg. and consisted of pearlite and temper carbon were annealed at 700 deg. for various periods of time and cooled in the air. When heated to 700 deg. for one-half hour part of the pearlite was decomposed and a narrow band of ferrite surrounded each particle of temper carbon. When heated for two hours about one-half of the pearlite was decomposed and the temperature resembled Fig. 10, though the outlines were not as definite. By heating the specimen for five hours at this temperature all of the pearlite was decomposed

and structure again consisted of ferrite and temper carbon. This experiment would seem to show that the final breakdown of the cementite may occur above the Ar_1 point. At the present time the effect of heating at temperatures above and below 700 deg. has not been studied.

It was noticed that particles of undecomposed excess cementite remained unchanged throughout these heat treatments, showing that it was stable in comparison with the dissolved cementite.

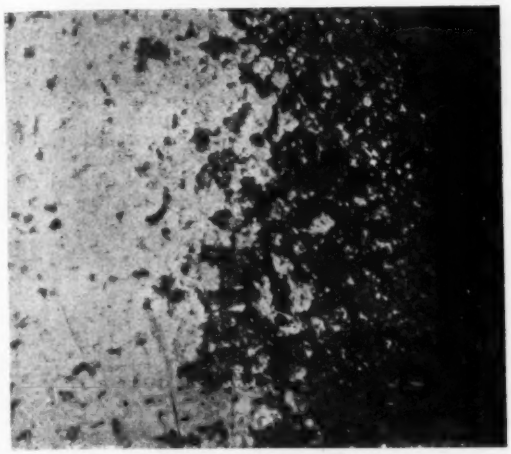


FIG. 5.—MAG. × 50.

If the temperature necessary to entirely decompose the iron, iron-carbide solution was below 800 deg., and if the reaction was negligible below 670 deg. it was evident that a good structure could be obtained by holding the specimens at the critical temperature upon cooling for the correct length of time and then cooling at a quick rate. It was also evident that a good structure could be obtained by annealing at this critical temperature and cooling rapidly. This was done, and although the time required was longer, owing to the lower temperature, a good structure resulted.

The temperature of the final precipitation of carbon is probably dependent principally upon the silicon and manganese content of the iron. The lower the silicon content the lower the temperature at which the iron carbide is stable.* The proportion of these elements will determine the critical range of the iron.

The conclusions to be drawn are:—

(1) A fast rate of cooling after annealing results in a steely structure.

(2) The critical cooling range is between 740 deg. and 830 deg.

(3) If the rate of cooling is sufficiently slow in the critical range, all of the carbon in the undecomposed austenite will be precipitated in that range.

(4) If the carbon is entirely precipitated in the critical range the rate of cooling below 700 deg. has little effect upon the iron.

(5) Very slow cooling will result in a ferrite rim.

Time of Annealing.

A number of experiments were run to determine the correct time of annealing at various temperatures. The results showed that a malleable structure was obtained in 36 hours at 870 deg. By raising the temperature to 985 deg. the time was cut to 18 hours, while at 740 deg. the necessary time was more than 70 hours.

Though the short, high temperature anneal looks attractive, it is not practicable owing to several reasons. It soon ruins the furnace, burns the saggers, and results in a poor grade of malleable iron. The lower the temperature of annealing the cheaper the upkeep of the furnace and the better the iron. Though the best product results from the 740 deg. anneal, this low temperature is usually prohibitive where cost must be considered, owing to the length of time.

Reactions in the Annealing Process.

A metallographic study of the specimens showed the successive reactions occurring in the process. The following data are significant in determining the reactions resulting in the malleable-iron structure:—

(1) When the malleable iron was heated for too short a time or at too low a temperature and slowly cooled, the structure consisted of ferrite, cementite and temper carbon. (Fig. 7.)

(2) By increasing the time at the maximum temperature or increasing the temperature the cementite areas were almost (Fig. 8) or entirely eliminated. (Fig. 6.) The structure then consisted of ferrite and temper carbon.

(3) By annealing at the proper temperature to insure the breakdown of all of the excess cementite, but cooling rapidly from this temperature, the structure of Fig. 10 resulted. This consists of temper carbon surrounded by ferrite, in turn enveloped by pearlite.

(4) When the rate of cooling was slower than in No. 3, the structure of Fig. 9 resulted. This is similar to Fig. 10, but the pearlite areas are much smaller.

(5) By annealing at too low a temperature and cooling rapidly, the specimen consisted of areas of

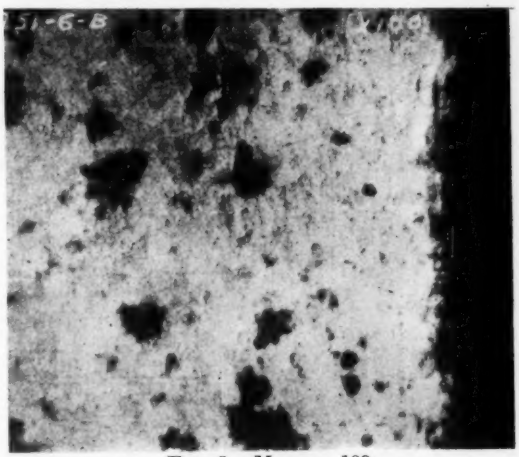


FIG. 6.—MAG. × 100.

excess cementite surrounded by pearlite and small particles of temper carbon surrounded by ferrite.

(6) When the malleable iron was reheated to about 800 deg. the temper carbon started to go into solution.

(7) It was possible to secure a complete decomposition of the dissolved cementite at 700 deg.

From these data the mechanism of the formation of the malleable structure could be deduced. The white iron consisted of cementite and pearlite. When heated to the annealing temperature this pearlite

* Charpy and Cornu, "Compt. rend."

went into solid solution as austenite. It is a question whether the breakdown of the cementite occurs directly from the excess cementite or whether it occurs from the iron carbide dissolved as austenite. Though the research did not result in any definite conclusions, it seemed to indicate that the excess cementite did not break down directly, but that it first went into solution as austenite, from which the carbon was precipitated.

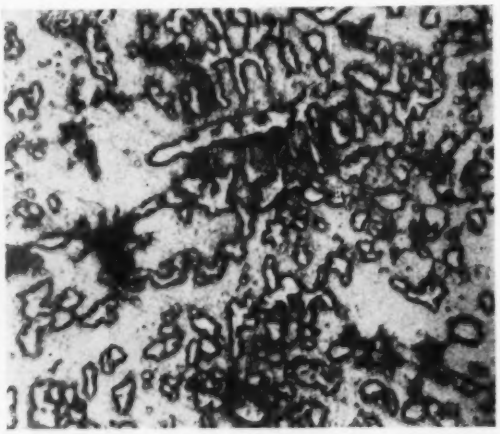


FIG. 7.—MAG. × 100.

If the excess cementite of the white iron broke down directly, the reaction should show some free graphite scattered in areas of cementite, since the decomposition would proceed uniformly throughout the carbide particles. Instead of a uniform breakdown and the scattered formation of temper carbon, these cementite areas grow smaller as though they were being gradually dissolved, while the temper carbon forms in large patches. There is no indication of a direct decomposition of the excess cementite.

If the cementite in the austenite decomposes and deposits the temper carbon the ferrite liberated will dissolve the excess cementite. The presence of the nucleus of temper carbon probably causes a more rapid breakdown of the dissolved carbide.

In the specimens examined in which excess cementite remained, owing to imperfect annealing, it was found that the cementite adjoining temper-carbon areas was usually much smaller than that farthest away. Usually the area directly about the temper carbon was free from cementite. This would be the result if the carbide in the austenite decomposed. Owing to the liberation of the ferrite at the temper carbon the concentration of this constituent would be greatest there and the excess cementite in the immediate vicinity would be more quickly dissolved than that farther away.

The stability of the excess cementite in the white cast iron is shown again in Fig. 11. This specimen was annealed in a case-carbonising mixture and the exterior portion retained the greater part of the excess cementite. Temper carbon and ferrite were also present in this rim. The interior showed a good malleable structure. In this case it is probable that the carbon necessary to replenish the austenite due to the decomposition of the dissolved carbide was obtained from the carbonaceous gases of the case-carbonising mixture, instead of from the cementite areas. The temper carbon in this rim was not surrounded by ferrite, but was scattered throughout the cementite areas, showing that the latter was more resistant than the gases to the dissolving action of the ferrite liberated at the temper carbon.

The decomposition of the iron carbide in the austenite is not complete at the annealing temperature, but is probably complete at 760 deg. By cooling quickly from the annealing temperature the specimen consists of nearly pure pearlite and temper carbon, or, if a piece of good malleable, consisting of ferrite and temper carbon, is heated to the annealing temperature, part of the carbon is quickly redissolved to form pearlite. By then annealing at 700 deg. all of the carbon may be precipitated.

This pearlite formation shows that the stability of the cementite dissolved in the austenite is a function of the temperature, which is determined more or less by the silicon and manganese ratio. The lower the temperature the less stable the iron carbide. The determination of the limiting temperature or where the cementite is completely unstable was not made, but is probably close to the eutectoid temperature, about 725 deg. to 775 deg. By cooling slowly through this temperature range the iron carbide may be entirely decomposed and ferrite and temper carbon obtained.

Since the cementite is unstable below this temperature, the breakdown of the iron carbide may be possible below the Ar_1 point, but the reaction is slower since it is at a low temperature and the carbide is not in solution. Therefore, if the rate of cooling is slow until 650 deg. or 700 deg. is reached, the cooling may be more rapid to the room temperatures. This is corroborated by the experimental evidence.

Where the cooling from the annealing temperature is too fast the iron carbide forms pearlite. (See Figs. 9 and 10.) Since the austenite about the temper carbon particles is richer in ferrite, the rejection of ferrite takes place here and the pearlite forms furthest from the carbon.

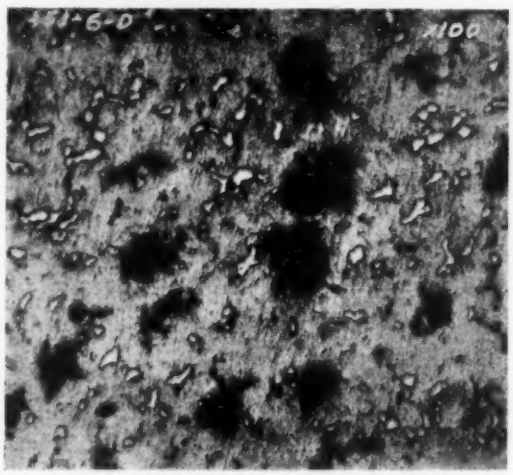


FIG. 8.—MAG. × 100.

The structure of the rim is also dependent upon the rate of cooling. If the carbon is oxidised from the surface to an extent which will result in a medium to a high-carbon steel, as shown in Fig. 5, and the rate of cooling is slow enough to prevent any pearlitic formation in the interior of the specimen, the cementite in the rim will probably be stable owing to the absence of carbon nuclei. If the rate of cooling is too slow even this cementite will decompose, forming a lower-carbon steel or a pure iron skin, as shown in Fig. 6. Areas of such partly-decomposed pearlite are shown in Fig. 12.

The skin effect has been a much discussed problem. Several different explanations of the disappearance of the carbon, or the decarburisation of the rim of malleable iron, have been offered. Some hold that the carbon migrates to the interior and remains in the casting, while others claim that the carbon migrates out and disappears entirely from the casting. It is obvious that if the carbon migrates out and leaves the iron at the temperature used for annealing, it must do so in the form of a gas. An analysis of the gases formed during the annealing would indicate their nature.

In the hardening and annealing of steels care must be used so that the surface does not become decarburised. Experience shows how easily and quickly the surface carbon is oxidised. This surface decarburisation is not alone a result of the action of oxygen according to the following reaction :—

$2Fe_3C+O_2=6Fe+2CO$

$2CO+O_2=2CO_2$ (with excess oxygen).

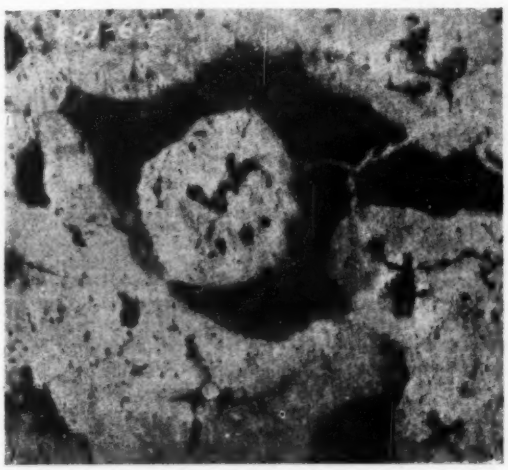


FIG. 9.—MAG. × 100.

The surface reaction may also be the result of the action of CO_2 on the iron carbide.

$Fe_3C+CO_2=3Fe+2CO.$

$2CO+O_2=2CO_2.$

$Fe_3C+CO_2=3Fe+2CO$, etc.

The amount of decarburisation is therefore dependent upon the presence of oxygen and carbon dioxide.

This reaction may be applied to the annealing process. Since the castings are somewhat inaccessible to the furnace gases the reactions and the rim decarburisation are slow. Where the furnace gases have a large excess of oxygen the reaction is more rapid than where less is used. The slower the oxidation the more steely the rim.

Even with a carbon packing it would be impossible to obtain a steel rim at certain low temperatures, owing to the equilibrium relations between CO_2 and CO. This equilibrium calls for more CO_2 at the lower temperatures, and for this reason a casting annealed at a lower temperature, 700 to 800 deg., would probably have a more decarburised rim than one annealed at above 800 deg. Where a carbon monoxide atmosphere is maintained, as in the case of the specimen annealed in a case-carbonising mixture, no surface oxidation results.

Some experiments were run to determine the gases resulting from the annealing operation. The reducing nature of the gas was shown in a preliminary experiment where a specimen was annealed in cupric oxide. The oxide was reduced, resulting in a mass of metallic copper. Samples of gas, which were being given off by specimens, were then taken and analysed.

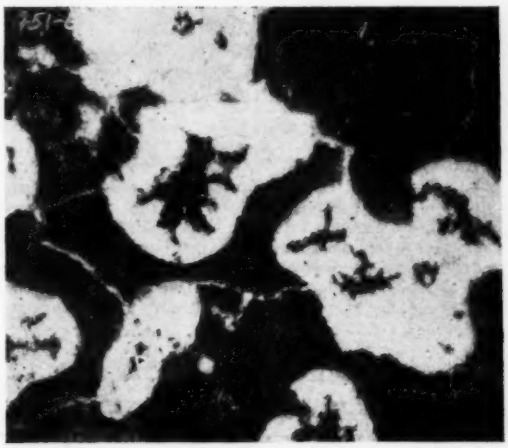


FIG. 10.—MAG. × 100.

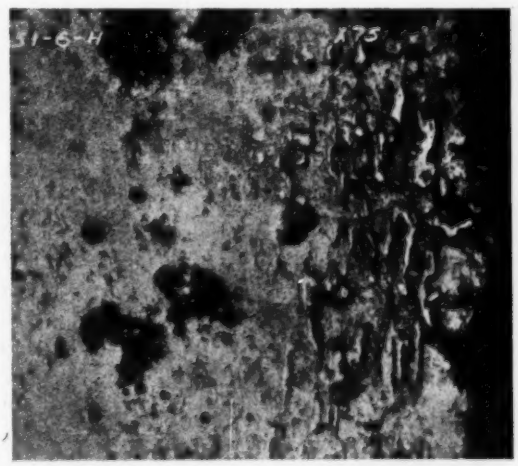


FIG. 11.—MAG. × 75.

The following gas was taken from a sample being annealed at 870 deg. :—

	[Per cent.
Carbon dioxide	13.2
Hydrocarbons	0.0
Oxygen	8.8
Carbon monoxide	26.8
By difference, nitrogen	51.2

A second sample was taken from one annealing at 980 deg :—

	Per cent.
Carbon dioxide	4.6
Hydrocarbons	0.0
Oxygen	3.4
Carbon monoxide	71.2
By difference, nitrogen	20.8

The above analyses show that the carbon is removed from the casting as a gas, the composition of the gas depending upon the temperature and oxygen present.

General Summary and Conclusions.

(1) This research has resulted in the affirmation of some of the established laws in the annealing of malleable cast iron, namely :—(*a*) That the packing material does not affect the interior structure; (*b*) slow cooling is necessary to obtain good malleable; (*c*) a low temperature of annealing gives a much better grade of product than the high-temperature malleable.

(2) The conditions influencing the rim structure have been investigated.

(3) The result of too rapid cooling has been studied, and is shown to result in a steely structure.

(4) The breakdown of the iron carbide has been studied, and though present results are not final all seem to show that cementite does not break down directly, but decomposes from the solid solution or austenitic condition. This breakdown may be compared to the electrolysis or decomposition of a salt. While it would be difficult to decompose a salt in the dry state, it is a simple matter to cause decomposition when dissolved in water. The ionic theory calls for a dissociation into ions when such a salt is dissolved in water.

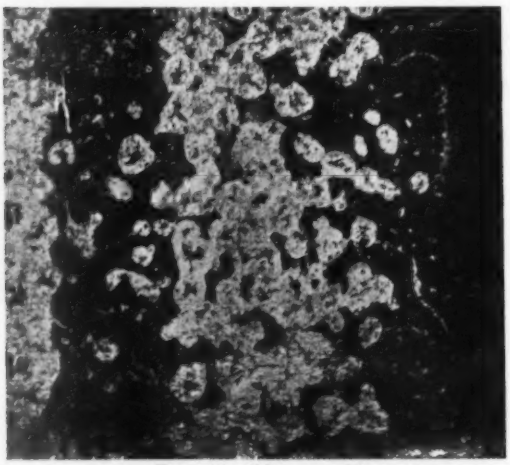


FIG. 12.—MAG. × 25.

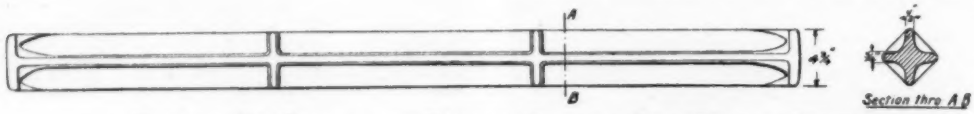
Cannot the case of the decomposition of iron carbide be compared to the decomposition or dissociation of a salt? The analogy is not perfect, but a comparison can be made.

(5) The decomposition of the iron carbide is complete above the Ar_1 point of the iron-carbon diagram. Whether iron carbide is unstable below the Ar_1 point has not been determined.

(6) The decomposition of the iron carbide is not complete at the annealing temperature but is complete in a range of temperature just above the Ar_1 point, as given in No. 5.

Cast-Iron Pit Props.

Owing to the war the supply of timber pit props, upon which most of the collieries in this country depend, has been seriously depleted. It is, however, the intention of all colliery owners to maintain as far as possible a regular output of coal, thereby keeping their men employed and at the same time supplying those works which, without coal, would have to close down. Several experiments have been made with other materials to replace timber, and one naturally turns to cast iron, which is well known to have a very high compressive strength. The Staveley Coal and Iron Company, Limited, Chesterfield, have recently carried out extensive tests with pit props of various sections made from this material, and have obtained some interesting results, a few of which are given in the subjoined table. As will be seen from the table, the first three tests were made with ordinary timber props pointed at one end, as generally used. After careful consideration as to efficiency combined with economy in manufacture, and easy handling at the pit, the Staveley Company have decided upon the "star" section, test No. 9, a sketch of which is shown herewith, which they are now in a position to supply.



CAST-IRON PIT PROP, BY THE STAVELEY COAL AND IRON COMPANY, LIMITED.

RESULTS OF PIT-PROP TESTS.

No. of Test	Section.	Length	Weight Cwt. Qr. Lbs.	Pressure on Ram in Lbs. per Sq. In.	Ultimate Breaking Load in Tons.	Material
1	6" dia.	6'·6"		110	11	Timber
2	6" dia.	6'·0"		200	21	"
3 *	6" dia.	5'·6"		120	13	"
4	4½" dia. x ⅝" thick	6'·6"	1. 0. 4	1,400	148	Cast Iron
5	3" dia. x ½" thick	6'·6"	1 0. 8	1,100	116	"
6	3" dia. x ⅜" thick	5'·6"	1·16	420	44	"
7	2½" hole thro ⅜" thick	5'·2½"	1. 1 3	1,600	169	"
8	4½" dia. x ½" thick	5'·6"	1 1·26	1,400	148	"
9	Solid	5'·3½"	3. 22	1,000	106	"
10	2⅝" hole thro ⅝" thick	5'·2½"	1. 0. 0	1,150	122	"
11	4½" dia. x ⅝" thick	5'·6"	1·0 3	1,300	137	"
12	4" dia. x ⅝" thick	5'·0"	3·5	1,500	159	"
13	3" dia. x ⅝" thick	5'·0"	3·12	1200	127	"

* Not broken Short of Length in Ram

MR. C. P. PERIN, consulting engineer for the works of the Tata Iron and Steel Company, Limited, Bengal, India, since its inception has returned to the United States.

A Core Bar for Making Bridge Caissons.

By John Sutor.

This segmented core bar is for the cheaper and quicker production of cores for caisson castings, viz., from 4 ft. diameter to 12 ft. diameter. Twelve segments are used on a 6-ft. diameter caisson core. The core bar, A, is an inner barrel, having taper faces at top and bottom ends on the outside. Around the top end at regular intervals are 12 holes, 1¼-in. diameter, and to allow the free escape of gases between the barrel and segments, a number of open-

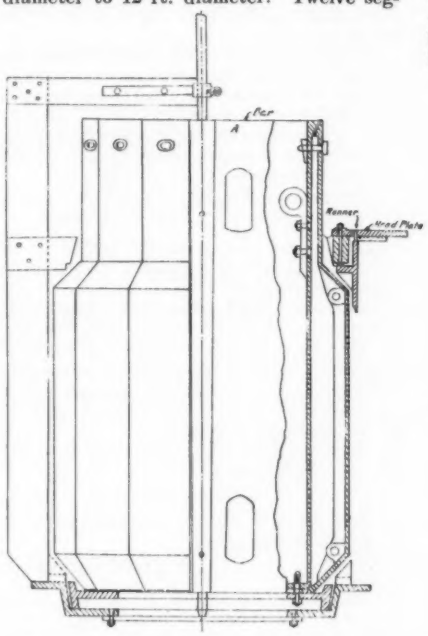


Fig. 1.—General Section.

Fig. 2.—Segment Outside.

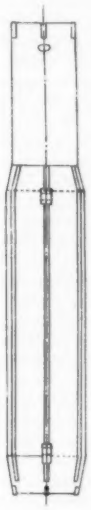


Fig. 3.—Segment Inside.

Core Bar for Bridge Caisson.

ings 1 ft. long by 6 in. wide, at top and bottom of the barrel are cast in to serve that purpose. The taper key bar, 2 in. thick and from 5 in. wide at the top to 4 in. wide at the bottom, is secured to the barrel with two 1-in. countersunk bolts. The whole bar is lifted with the three eye-bolts as shown, and an inner flange at the bottom of barrel is used to secure the whole firmly together.

The segments are secured around the barrel by 1½-in. cotter pins with large circular heads 3 in. diameter. The segments at top and bottom have narrow chipping bearings to ensure firmness on the

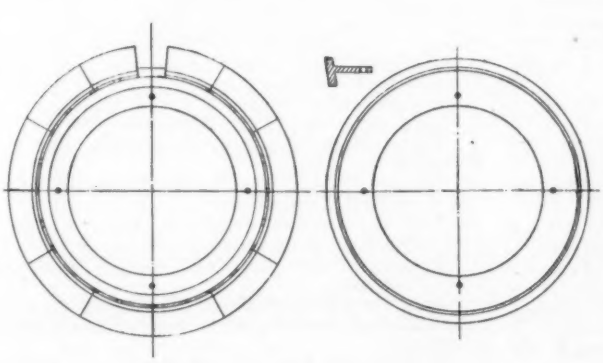


Fig. 4.—Top and Bottom Views of Seat Ring.

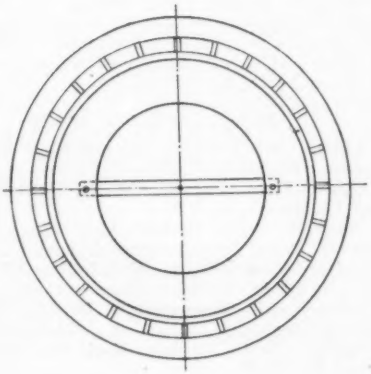


Fig. 5.—Dish.

Core-bar for Bridge Caisson.

taper ends of the barrel. Each segment to strengthen it has three ribs cast on to keep it in alignment, and 2-in. holes are cast in the centre rib for lifting purposes. A space of ⅜ in. is allowed between each segment. The chippings form the bearings as they are more easily adjusted.

The barrel with the segments stands in the seat ring. The seat ring forms the foundation for the barrel and segments, and the raised outer rim forms the groove in which the segments stand. The seat ring is secured to the barrel by three cotter bolts, the space in front of the key bar being securely filled in with loam bricks, and ½ in. of loam is allowed on the face of the seat ring. The dish, having the bracketted flange secured to it by four ¾-in. countersunk bolts, forms the seat, bottom flange, and also acts as guide for length and diameter of core, with the core board. The head plate consists of a circular ring having four handles for lifting, a number of 4-in. holes for runners, also four holes 3 in. long by 1¼ in. wide. A ring is cast to the same inner diameter as the cover plate, and having four holes corresponding with above, by which it is secured in position with four ¾-in. bolts having flattened heads, 1 in. of clearance being allowed on and around the ring for loam. This head plate has a taper seat corresponding to the top of the core, and also takes bearing on the outside of the mould. It also forms a head 6 in. deep, which is cut off with the lathe in the fitting department.

After being cast, the cotter pins are withdrawn from top and bottom; the barrel is then lifted out and placed upon another seat ring in readiness. The segments are then taken out, two at once, and placed in position around the barrel, the operation taking 30 minutes, the whole core being ready for stoving in three hours. This method secures economy where a number is required, and as there are no bricks used none are wasted. There is also a saving of loam in building, as there is only ¾ in. of loam on the face of the segments.

American Foundrymen's Convention.

Papers to be Read.

Among the Papers to be read at the forthcoming Annual Convention of the American Foundrymen's Association, the American Institute of Metals, and the allied bodies, at Chicago on September 7 to 11, are the following :—

Papers on Safety Work.

"Safety in Foundry Operations," by M. W. Alexander (General Electric Company).

"Safety First," by W. F. Riedenbach (Genesee Metal Company).

"Progress in the 'Safety First' Movement," by Arthur T. Morey (Commonwealth Steel Company).

"Safety in connection with Grinding Wheel Operations," by R. G. Williams (Norton Company).

"Safety and Sanitation," by A. W. Gregg (Bucyrus Company).

"Safety First—Driving Back the Saloon," by Thomas D. West.

Foundry Equipment and Appliances.

"Electric Motors and Controllers for Foundry Operations," by S. H. Libby.

"The Second Storey Foundry," by G. K. Hooper (Hooper-Falkenau Engineering Company).

"Economics of Motor Drive," by H. F. Stratton (Electric Controller and Manufacturing Company).

"Abrasives in the Foundry," by Mr. Dietz (Norton Company).

"Refractory Material," by Mr. Kelly (Harbison-Walker Refractories Company).

"Moulding Sand Tests," by Dr. Richard Moldenke.

Cost Congress.

"Foundry Cost Keeping," by F. J. Stevenson (Cost Expert, National Association of Stove Manufacturers).

"Efficiency in Foundry Operations, the Essential Factor in Reducing Production Costs," by A. K. Hathaway (Tabor Manufacturing Company).

"Efficiency in Foundry Work," by F. A. Parkhurst (Aluminium Castings Company).

"Revision of the A. F. A. Standard Foundry Cost System," by Harrington Emerson.

"Prevailing Practice in Estimating the Selling Price of Castings," by A. O. Backert.

Malleable Cast Iron.

"Manufacture of Malleable Cast Iron," by Harold Hemenway.

"Test of Malleable Cast Iron," by Enrique Touceda.

"Effect of Silicon and Carbon in Malleable Iron Practice," by A. L. Pollard (Johnston Harvester Company).

"Malleable Iron Practice," by J. P. Pero (Missouri Malleable Iron Company).

"Researches in the Annealing Process for Malleable Castings," by Oliver W. Storey.

Steel Castings.

"The Electric Furnace in the Steel Foundry," by W. L. Morrison.

Discussion of Mr. Morrison's Paper, by G. J. Stock.

"Making Steel Direct from Ore in the Electric Furnace," by Prof. T. A. Louden.

"Side-blow Converter Practice," by John Gregson (Sivyer Steel Casting Company).

"Manufacture of Acid Steel for Castings," by A. F. Blackwood.

"Notes on the Microstructure of Steel," by Prof Wm. Campbell.

"Some Defects in Steel Castings and Remedies for Them," by John Howe Hall.

"Report of the Committee on Steel Foundry Standards," by Dudley Shoemaker.

Grey-iron Castings.

"Cast Iron with Unusual Structure," by K. W. Zimmerschied (General Motors Company).

"Elimination of Waste in Bench Moulding," by J. C. Pendleton and R. E. Kennedy.

"Report of the Conservation Congress," by Paul Kreuzpointer.

"Report of the Committee on Industrial Education," by Paul Kreuzpointer.

"Iron and Its Properties," by Peter F. Blackwood (Michigan Steel Castings Company).

"Green-sand Cores," by James Mulvey (Rensselaer Valve Company).

"Dangers of Specialisation," by Thomas D. West.

"Semi-Steel," by R. H. Probert (James Leffel & Company).

"Tests of Cast Iron," by W. P. Putnam (Detroit Testing Laboratory).

"Memorandum on the Preparation of Standard Specifications for Cast Iron for International Export Use." by Dr. Richard Moldenke.

"Industrial Pioneering, or the Establishment of a Foundry in a New Territory," by L. L. Anthes (Anthes Foundry Company).

Annealing Furnace for Non-Ferrous Metals.

By the courtesy of the management, our representative was recently allowed to inspect the latest design of furnace installed by the British Insulated and Helsby Cables, Limited, Prescot, Lancashire,

SECTION ON A.B.

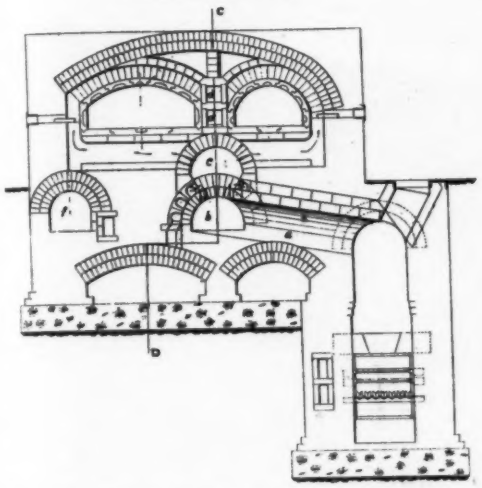


FIG. 1.—BATES & PEARD ANNEALING FURNACE.

for bright annealing copper wire, which is on the principle of the Bates & Peard Annealing Furnace Company, Huyton, near Liverpool, but which is really a happy combination of that Company's system with the gas producer of Messrs. Gibbons Bros., Limited, of Dudley.

sealed by the water contained in tanks on both the receiving and delivery sides of the furnace. The material for treatment is fed on to an endless conveyor, which passes from tank to tank by way of the annealing chamber and returns through tunnels below the ground line and clear of the water. The drums which carry the conveyor are driven through a worm wheel on one side of the drum by a worm on the shaft, which worm is operated by a ratchet wheel, also fixed on the shaft, this being in turn driven by a pawl which receives its reciprocating motion from an eccentric attached to a counter-shaft. The conveyor is guided by rollers within the tanks, and guide plates are provided to prevent the material fouling.

The general design of the furnace and producer is very similar to the rotary billet-heating furnace made by the same firm, except that in the case of the annealing furnace, as the conveyor returns below the furnace the producer has to be placed by the side of, instead of underneath, the setting. The particular arrangement will be readily followed from the accompanying illustrations (Figs. 1 and 2).

Coke is used as fuel, and the carbonic oxide generated in the producers is carried by the cross flues *a* to the longitudinal tunnel *b*, which runs parallel to the retorts, but some 2 ft. below them. From this tunnel the gases pass upwards to the combustion chamber *c*, through nostril holes formed in the arch. As the gases pass through these nostril holes they are met by a regulated supply of secondary air, and are here ignited and burnt to CO_2. The burning gases are then led under and round the retort in 9-in. flues separated from each other by the 9-in. walls which support the retorts throughout their length, and then travel along the flue *d*, between the retorts, to either end of the setting. At the ends of the setting the gases pass over the retorts in the reverse direction, returning under the retorts and then down, past regulating dampers, into the cross flues *e*, connecting to the main flue *f*. The secondary air is heated up by leading it over and alongside the main flue and thence to the system of horse-shoe blocks, through which it travels to the nostril holes where the monoxide gas enters the combustion chamber.

Fig. 3 shows the double-tube furnace, which is

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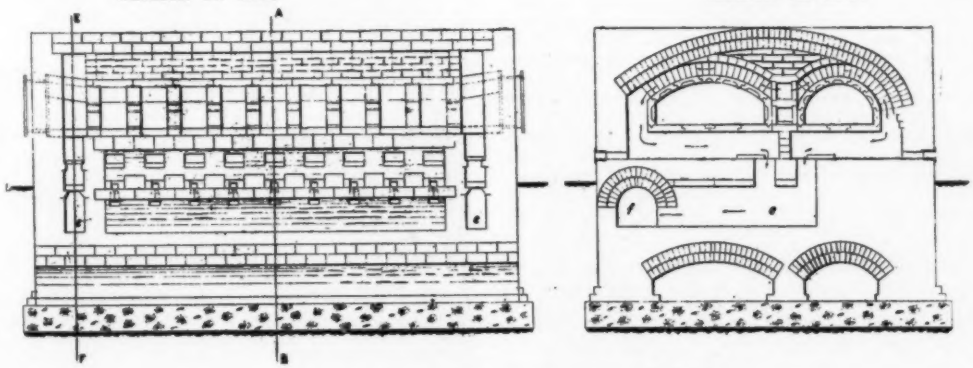


FIG. 2.—BATES & PEARD ANNEALING FURNACE.

The general principle of the Bates & Peard system has now been in successful operation for some years, the essential features being the arrangement of an annealing chamber whose open ends dip into and are

15 ft. 3 in. from wall to wall. The furnace is provided with electric pyrometers, and any desired temperature up to 1,400 deg. F. is readily obtainable. The wire put in as coiled takes 145 minutes to travel

from end to end, the time from wall to wall being 45 minutes. The furnace has an output capacity of 59.4 tons in 24 hours, with a fuel consumption of 3 per cent. by weight of the metal, common gas coke being burnt. The wire leaves the furnace perfectly bright, and with a breaking strength of 14.8 to 15 tons per sq. in., and an elongation of 35 to 40 per cent.

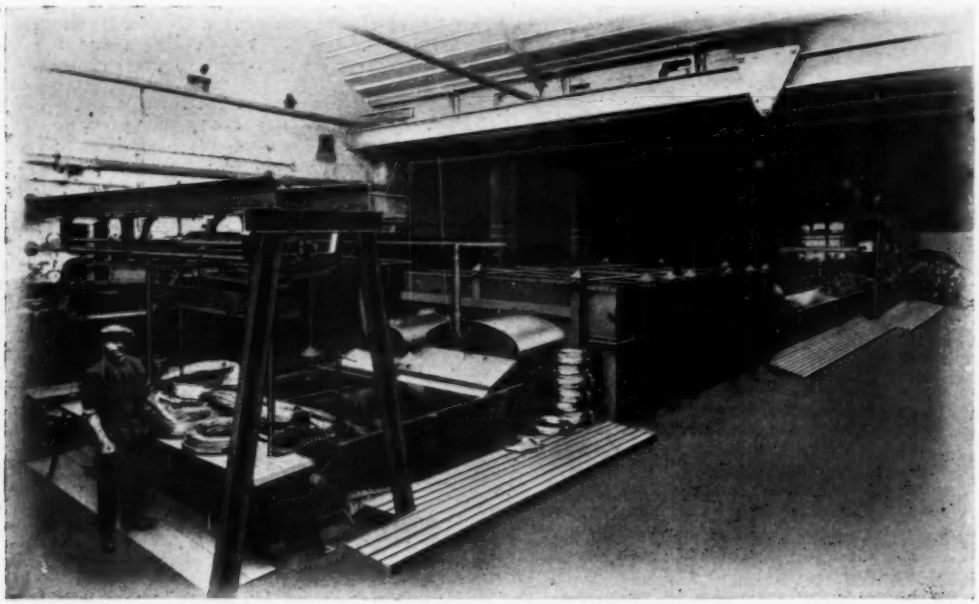


FIG. 3.—ANNEALING FURNACE AT WORKS OF THE BRITISH INSULATED AND HELSBY CABLES, LIMITED.

LIGHT AND LABOUR.—A diagram prepared by Mr. A. C. Popoke, and recently published in the "Electric Journal," shows that the cost of energy and maintenance of the lighting equipment is much the smallest item in the various charges against a particular machine tool. The charges shown may be larger or smaller than the average, but they have been selected from a typical instance. From this diagram it will be seen that the lighting is an insignicant expense compared with the other charges. In spite of the comparative inexpensiveness of the lighting, it may, if inadequate or glaring, be the cause of failure on a particular piece of work. For example, the cost of energy and maintenance for a single lamp may amount to about 1s. per month. The workman who depends on this lamp receives 8s. per day in wages; hence the daily cost of lighting is equal to two minutes' wages. A workman can easily lose 20 or 30 minutes every day (10 to 15 times the value of the day's lighting) if handicapped by insufficiency of artificial illumination. The British Thomson Houston Company point out that when the losses due to defective work are added to this loss of time, it will be seen that, although good lighting may cost very little, its economic possibilities are very considerable.

THE value of the personal estate of the late Mr. H. Rogerson, manager at the Calderbank Steelworks, Airdrie, is £1,175.

Electro-Magnets in Foundry Service.

The electro-magnet has so well demonstrated its utility in foundry operations that it ranks as a standard item in up-to-date equipment. Among other features, it dispenses with the use of chains and slings and while considerably increasing the utility of the cranes, also greatly reduces the labour involved in the handling of materials. Further, it will lift either hot or cold material and its use is independent of the shape of the article or material to be handled.

Electro-magnets can be used with great advantage for handling either heavy or light materials, such as rails, girders, shafting, bars, plates, ingots, pig-iron, castings, forgings, scrap iron, stampings, turnings, filings, bolts, etc.; also for lifting and dropping the iron balls employed for breaking up scrapped castings in foundries, for the raising and dropping of the monkeys of pile-driving machines, and for lifting floor plates in steel works.

The wide application of the electro-magnet is well-illustrated in an extensive series of photos taken by Messrs. E. G. Appleby & Company, 12, The Broadway, Westminster, S.W., the makers of the "Phœnix" electro-magnets. A selection of these photos are reproduced herewith. Fig. 1 shows a 52-in. magnet lifting three furnace doors; Fig. 2 shows a 36-in. magnet lifting light scrap. Other examples of the handling of light but difficult material are shown in Fig. 3, which depicts a 52-in magnet lifting turnings, and Fig. 4, which illustrates a similar magnet discharging a load of fine cast-iron borings.

FIG. 1—MAGNET LIFTING THREE FURNACE DOORS.

FIG. 3.—MAGNET LIFTING STEEL TURNINGS.

FIG. 2.—MAGNET LIFTING LIGHT SCRAP IRON AND STEEL.

FIG. 4.—MAGNET DISCHARGING A LOAD OF FINE CAST-IRON BORINGS.

"F.T.J." Bookshelf.

The Metallurgy of Non-Ferrous Metals. By William Gowland, F.R.S., A.R.S.M. (London: Charles Griffin & Company, Limited, Exeter Street, Strand, W.C.)

This is a book covering a very wide field of metallurgical knowledge, partly based, we presume, on Professor Gowland's lectures as Professor of Metallurgy in the Royal School of Mines. It deals with copper, lead, gold, silver, platinum, mercury, zinc, cadmium, tin, nickel, cobalt, antimony, bismuth and aluminium. With such a scope it might, of course, be expected that each metal would be dealt with briefly, but it is extraordinary how much valuable information Professor Gowland has managed to condense into such a comparatively small space, and the work will, we think, add greatly to the author's reputation as a teacher of metallurgy. The general plan followed is to consider under the name of each metal (1) its physical and chemical properties; (2) the alloys of which it is the chief constituent; (3) the composition and applications of commercial brands, and the effects of substances which interfere with those applications; (4) the chief ores and the processes by which the metal is extracted from them or other sources and refined or made suitable for industrial or other purposes; (5) the principles and conditions on which the success of these processes depend; (6) the furnaces and appliances employed in the processes, and the chemical changes and reactions which occur in the operations; and (7) examples of actual practice followed at the present time in important extraction works.

La Cémentation de l'Acier. By Frederic Giolitti. (Paris: Librairie Scientifique, A. Hermann et Fils, 6, rue de la Sorbonne.)

Professor Giolitti is connected with the Turin Polytechnic, and his work has been translated into French by Mons. Albert Portevin, Chief of the Metallurgical Department at L'Ecole Centrale, Paris. The treatment of special steels, as is the case in many metallurgical processes, has up to the present been most empirical. As the result, however, of the scientific investigations of the last ten years, in which Sheffield workers have played a very important part, the processes have now been placed upon a sound scientific basis, and the author of this book summarises and discusses what has been done in this direction. It is some satisfaction to find that a good deal of work has been done by English investigators, but Professor Giolitti himself has probably done as much as anyone, and his intimate knowledge of the subject lends great weight to the criticism and review which he gives of the work of others. A particularly interesting chapter is that dealing with the actual state of our knowledge at the present time of cementation work, previous to which the most recent investigations on the subject are reviewed. This review carries us up to what has been accomplished within the last two years. The second half of the volume is of a practical character and describes the industrial applications of cementation and case-hardening processes. This section of the work occupies 250 pages and describes the plant and methods in use.

Transactions of the American Institute of Metals. Vol. VII. Edited by W. M. Corse, Secretary. (Buffalo, New York, U.S.A.: American Institute of Metals).

This volume of the Institute's "Transactions" covers the Seventh Annual Meeting, held at Chicago, October 13 to 17, 1913. Nearly 400 pages are occupied by the Papers and reports of discussions thereon, among these being very many of great interest to the non-ferrous founder. The subjects include metallurgy, foundry practice, works organisation, apprentice training, costing, safety, and the work done by the Bureau of Standards, the volume thus representing an excellent summary of the year's work of the Institute and its members. In addition to the foregoing are included about 90 pages of the Institute's bulletins containing abstracts of metallurgical literature and patents, notes and reports during 1913, and a list of members.

The Channel Tunnel.—This is a pamphlet on the military aspect of this question by the Right Hon. Lord Sydenham of Combe, formerly secretary of the Committee of Imperial Defence. Issued from the House of Commons: Grand Committee Room No. 10.

Catalogues, &c.

British Aluminium Company, Limited, 109, Queen Victoria Street, London, E.C.—Leaflets on "Aluminium Castings" and "Aluminium Tread-Plate" have been received from this company; also a wall sheet giving in tabular form a good deal of information regarding dimensions, weights, etc., of aluminium tubes, rods, bars, strip, sheets, shapes, etc.

Edward Duisberg, 28, Victoria Street, Westminster, S.W.—A catalogue on twist drills, which is being circulated amongst works' managers and shop superintendents, contains a good deal of interesting information on the use and care of these tools.

The Westinghouse Cooper Hewitt Company, Limited, 80, York Road, King's Cross, London, N.—List No. 72 deals with Cooper Hewitt lamps for direct-current circuits, and List No. 73 with silica lamps for direct-current circuits.

James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.—A well-prepared illustrated booklet issued by this Company deals with the application of the "Keith Light," high-pressure incandescent gas, for engineering and other factory lighting, and also for street and similar lighting. Mill lighting forms the subject of a similar booklet, in which are described "Keith" gas compressors and lamps, while also several mills lit by the system are shown.

Alldays & Onions' Pneumatic Engineering Company, Limited, Great Western Works, Birmingham.—Section F of this Company's catalogue covers gas boosters and exhausters, including various designs of "Climax" Roots-type blowers, for belt-drive or direct-coupled to steam engines and motors, rotary hand blowers, speed regulators, etc. The catalogue should interest all users of blowers and exhausters, as a wide range is covered by the different apparatus illustrated. Interesting information on the installation and care of blowers is also given.

Correspondence.

Hints on the Cupola.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—"The Hints on the Cupola for Beginners" in your August issue, p. 522, are very interesting, and we no doubt all find we have something to learn about cupola management. I shall be pleased if the writer will inform us whether or not the proportions of fuel to iron in charging the cupola are parts by weight or parts by measure. Also, with reference to the flux mentioned, will the writer please say what flux is recommended and also, if possible, the chemical constituent parts of the flux? This information will oblige.

"TYRO."

Skipton,
August 18, 1914.

Inventions.

Applications for Patents.

An Asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicator are in brackets.

16,226. Pipe-bending machines. J. Major.
16,263. Electric furnaces. J. L. Dixon.
16,324.*Apparatus and method for feeding liquid metals. P. Reichhardt.
16,386, 16,387 & 16,388. Metallic alloys. J. F. Duke.
16,632. Furnaces. C. Edmeston, sen.
16,895. Fixture device for light cast-metal pipes. Smith & Wellstood, Limited, and G. A. Ure.
16,901.*Electric furnaces for producing steel and iron. C. Brackelsberg.
16,902.*Regenerative furnaces using cold gases. B. Päschke.
16,970. Ovens or kilns for annealing iron castings, etc. Gibbons Brothers, Limited, R. Masters, and R. Baker.
17,064. Process for the removal of scale oxide and grease from metallic surfaces. S. O. Cowper-Coles.
17,157.*Alloy. C. R. Denton.
17,161.*Process for manufacturing iron-oxide castings. Soc. Italiana di Elettrochimica.
17,285.*Treatment of steel. A. Hethey.
17,425.*Furnace electrode. (Elektrochemische Werke G.m.b.H., Germany.)
17,426.*Producing flows in the molten masses of electrical furnaces. (Elektrochemische Werke G.m.b.H., Germany.)
17,453. Driving and reversing gear for planing machines. J. A. Paterson and Widnes Foundry Company, Limited.
17,504. Casting shell charges. (J. E. Mathews, United States).
17,584.*Reversing regenerative furnaces. L. L. Knox.
17,598. Process for hardening and improving the condition or quality of materials such as iron, steel, etc. A. Hirschl.
17,909. Electric furnaces. J. L. Dixon.
17,985.*Moulding-devices. (Foreign Patents Corporation, United States.)
18,346. Annealing-furnaces. Gibbons Bros., Ltd., and R. Masters.
18,387.*Process of heat treatment of steel. (Soc. Anon. Italiana Gio. Ansaldo & Company, Italy.)
18,429.*Apparatus for melting metals. J. E. Lowden.
18,471.*Furnaces. A. Chantraine.
18,472.*Recuperator. A. Chantraine.
18,473.*Furnaces. A. Chantraine.

Abstracts of British Patent Specifications recently Accepted.

24,138 (1913). *Pneumatically Operated Foundry Moulding Machines.* J. P. O'Donnell, Palace Chambers, Westminster, London, S.W.—This invention has for its object improvements in jarring machines, wherein a piston or plunger, provided with means for carrying the flask or moulding box and pattern, is raised in a cylinder by means of compressed air admitted to the cylinder, and when the piston reaches the limit of its upward stroke the compressed air is exhausted from the cylinder. The piston then drops by gravity until its lower end comes in contact with or strikes the usual jarring block, whereupon compressed air is again admitted to the cylinder for raising the piston. A compressed air admission and exhaust valve is provided and so arranged that at the proper time it admits compressed air to and exhausts it from the cylinder so that the piston is alternately raised and drops in the cylinder, whereby a series or succession of bumps or jars is given to the moulding box carried by the piston for compacting the moulding material about the pattern. The present invention consists principally in an improved controlling valve for alternately admitting compressed air or motive fluid to and exhausting it from the cylinder of the moulding machine.

1,431 (1914). *Apparatus for Compressing the Sand in the Boxes of Moulding Machines.* O. Eisele, 32, Panikengasse, Vienna XV., Austria.—This invention relates to apparatus for compressing or ramming the sand in boxes or flasks of moulding machines by successive applications of pressure, in order to obtain a sufficient compression of the moulding sand even in large boxes or flasks by means of a simple hand press. In order to enable the whole of the pressing to be effected by means of the press-cross-beam and to reduce the force required to a minimum, whilst preventing loosening of already compressed parts of the sand during compression of other parts, there is provided a multi-part plate in the form of frames, rings or blocks which are not attached to the press-cross-beam, but are adapted to be laid loosely on the sand to be compressed in the box or flask, and are freely movable relatively to each other. One or more transverse bars are also provided which are adjustably mounted on the cross-beam in such a manner that they can be brought into engagement with any one or more of the parts of the multi-part pressing piece. In some cases they may be themselves used for compressing the sand either directly or through blocks attached thereto. By this means, when the pressure is being applied to one of the parts of the pressing piece, the other parts lie on the surface of the sand and prevent displacement of the parts of the sand adjacent to that under pressure.

Suspension of German and Austrian Patents.

The Board of Trade have issued Rules under the Patents, Designs and Trade Marks (Temporary Rules) Act, 1914, regulating the procedure for the avoidance or suspension of any patent or licence granted to, or trade mark the proprietor of which is a subject of any State at war with His Majesty. Where an application is made to the Board for this purpose they must be satisfied that the applicant intends to manufacture the article concerned or carry on the patented process, and also that it is in the public interest that this should be done. The rules provide also for the avoidance or suspension of any application for a patent or trade mark by the subject of an enemy State. Copies of these Rules may be obtained from the Superintendent of the Sale Branch, Patent Office, 25, Southampton Buildings.

The secretary of the British Empire Industrial League, of 55-56, Chancery Lane, W.C., issues the following statement:—"The action on the part of His Majesty's Government in passing an Act permitting the avoidance or suspension of patents granted to persons who are subjects of Germany and Austria does not appear to be appreciated by many British manufacturers, for the reason that 'the Board of Trade may at any time in their absolute discretion revoke any avoidance or suspension of any patent or licence ordered by them.' It is evident that our manufacturers require something more definite and reassuring, so that, after laying down special plant for the manufacture of a particular article, the reinstatement of the patent at the end of the war would not mean that his capital and efforts had been wasted. With respect to trade marks, manufacturers should have some guarantee that there will be no exclusive reinstatement. Otherwise, a manufacturer might spend thousands of pounds in creating a trade the benefits of which would eventually accrue to the original alien owner."

Messrs Doherty & Bamber, of 25, Victoria Street, Westminster, London, S.W., announce that owing to all centrifugal pump supplies for the Turbo Electrical Company being shut off by the war, they have made arrangements whereby customers of the Turbo Electrical Company can be supplied with machines built by first-class English manufacturers. "Eureka" duplex steam pumps and geared pumps are arriving from Christiania without any delay.

Trade Talk.

J. Hopkinson & Company, Limited, of Huddersfield, have removed their London office to Imperial House, Kingsway, W.C.

An issue of preference shares of the Mond Nickel Company, Limited, is being offered to the shareholders at par.

Marshall, Cotterell & Company, Limited, 6, Lloyd's Avenue, London, E.C., have taken up the manufacture of tungsten.

Fraser & Chalmers, Limited, of Erith, Kent, have appointed Mr. H. A. Sturgess, The Oak, Motherwell, as their Scotch agent.

Mr. F. Robinson, iron and steel merchant and agent, 39, Exchange Buildings, Birmingham, is paying a first and final dividend of 5s. 1d. in the £.

Joseph Kaye & Sons, Limited, Lock Works, Leeds, have received further orders from H.M. Navy for about 4,000 of their patent seamless oilcans.

In consequence of a mishap a hematite furnace has been put out at the Thornaby-on-Tees works of Wm. Whitwell & Company, Limited.

The French Government will allow applications for patents to be made without payment of the usual application fee of 100 fcs. Such payment is only to be made after the war, and on a date to be subsequently fixed.

Messrs. R. Needham & Company, manufacturers of steel alloys, have removed from the Ferro Works, Hollis Croft, Sheffield, to Ferro Works, Wadsley Bridge, Sheffield.

The immediate discharge from bankruptcy has been granted to Mr. A. H. Whatton, iron merchant, late 85, Lower Street and Thistleberry Avenue, Newcastle-under-Lyme.

The Admiralty have notified Messrs. Robert Warner & Company, Walton-on-the-Naze, that they have been placed on the Admiralty list for the "Anthony" direct acting steam pump.

The iron merchants' (warehouse) business carried on as Pfeil & Company, at 145, etc., St. John Street, Clerkenwell, London, E.C., will in future be known as Farmer & Company.

The British Electrical Plant Company, Limited, Alloa, N.B., have appointed Mr. A. Williams, of 9, Queen Victoria Street, E.C., as their agent for London and the South of England.

A fire broke out on August 16 at the East Hecla Works, Sheffield, of Hadfields, Limited. The damage, which was not exceptionally heavy, was confined to the drawing and general offices.

Messrs. W. S. Glover and B. Gaffney, carrying on business as engineers, at 12, Eldon Square, Newcastle-upon-Tyne under the style of Glover and Gaffney, have dissolved partnership.

Musgrave & Company, Limited, of St. Ann's Iron Works, Belfast, have appointed Messrs. D. T. Keymer & Company, of Calcutta, as their agents for the eastern side of India and for Ceylon.

The whole of the regulations issued for technical schools, schools of art, etc., in England and Wales, have been consolidated and published by the Board of Education as a single volume.

The Parkgate Iron and Steel Company, Limited, have celebrated the jubilee of the business by the opening of new offices, the staff now being housed in extensive buildings presenting a fine frontage to Broad Street, Sheffield.

A notice has been issued by eight of the leading shipping lines in the South and East African trades that the surcharge on freight of 33 1-3 per cent., due to the war, is to be reduced to 25 per cent. until further notice.

Wellman, Seaver & Head, Limited, have received an order from the Bynea Steelworks, Limited, of Loughor, for an overhead open-hearth charging machine, this being a repeat order for a similar machine supplied last year.

The partnership heretofore subsisting between Messrs. F. Sutcliffe and W. Taylor, carrying on business as general ironfounders, at Arden Works, Fenton Road, Halifax, under the style of Sutcliffe and Taylor, has been dissolved.

The Government have accepted the offer of the Metropolitan Carriage, Wagon and Finance Company, Limited, to undertake to bear the whole of the expense of the special equipment of a battery of heavy guns which has just been mobilised at their works.

The partnership heretofore subsisting between Messrs. J. Moores, A. J. Moores and W. P. Bailey, carrying on business as locomotive boiler makers and repairers, at the Mill Lane Boiler Works, Bedminster, Bristol, under the style of Moores, Son and Bailey, has been dissolved.

A petition has been presented to the Lord Ordinary officiating on the Bills at Edinburgh, at the instance of Arthur Owen, 1, Mile House, Burnham, Bucks., for sequestration of the estates of Eric William Campbell, steel manufacturer, Lochcote, Linlithgowshire.

The two furnaces recently damped down at the Distington Hematite Ironworks, Distington, near Workington, have now been put into operation. An additional furnace is being prepared at Cleator Moor by the Whitehaven Hematite Iron and Steel Company, Limited.

Yarrow & Company, Limited, of Scotstoun, near Glasgow, have promised to distribute £1,000 amongst their officials and men if the firm are fully satisfied with the speed of completion, when the last of the three new destroyers, "Miranda," "Minos," and "Manly," has been handed over.

On the application of the various railway companies of the United Kingdom the Board of Trade have decided to amend the classification of merchandise traffic and schedules of maximum rates and charges fixed in pursuance of the Railway and Canal Traffic Act, 1888, by adding cadmium metal to Class 5.

The business of William Beal, Limited, brassfounders, Birmingham, and of the Birmingham Lamp and Gasfittings Company, Limited, brassfounders, Birmingham, have been amalgamated under the style of Beal, Greenwood & Company, Limited, Hinckley Works, Birmingham.

The firm of A. and R. Smith, carrying on business as brassfounders, etc., at 58 and 60, Anderston Quay, Glasgow, of which Mr. Andrew Smith and Mr. Robert Smith were the sole partners, has been dissolved by the retirement of the former. The business will be continued by Mr. Robert Smith on his own account under the same name.

The Shipping, Engineering and Machinery Exhibition, which was to have been opened at Olympia on September 25, has been postponed, we understand, until next year, when the promoters trust a successful exhibition will be held under more favourable auspices. Practically the whole of the exhibitors have consented to this arrangement.

The firm of Ritchie, Graham and Milne, engineers, etc., Whiteinch, Glasgow, of which Mr. Henry Ritchie, Mr. William Ritchie and Mr. Henry Robb were the sole partners, has been dissolved by the retirement of the last-named. The business will be continued by Mr. Henry Ritchie and Mr. William Ritchie under the same name, and they will discharge the liabilities.

In response to a request from the French Government to be allowed to take over all or part of the machinery at their depôt at Asnières, near Paris, Joseph Rhodes & Sons, Limited, of the Grove Iron Works, Wakefield, have given their consent. It is not known yet what plant has been requisitioned, but the firm have instructed their French manager to place everything at the depôt at the disposal of the Government.

Mr. R. W. Dana, secretary of the Institution of Naval Architects, intimates in a circular to members of that body that the council are considering the advisability and possibility of taking action as a society with the object of helping the country at the present crisis. Members who are in close touch with the Admiralty have advised that it is better for individuals to apply themselves to the proper quarter needing their service.

The second Northern International Engineering Exhibition will be held at the City Exhibition Hall, Man-

chester, from Friday, October 29, to Saturday, November 20, 1915. The exhibition is being organised by the Northern Engineering Industries Exhibitors' Committee, in the same manner as the recent second Northern Colliery and Mining Exhibition held under the auspices of a similar committee representing the colliery machinists of this country.

THE president and committee of the Institution of Mining and Metallurgy are to be congratulated for their patriotic action in deciding to organise a volunteer corps of members and associates. The offer was immediately accepted by the War Office, who quickly recognised the importance and value of such a corps of experts for defensive purposes. Needless to say, the response to the call for volunteers was unanimous, over 150 members enrolling during the first 24 hours.

THE NATIONAL TIME RECORDER COMPANY, 5, Blackfriars Road, London, S.E., are supplying thirty of their patent check-action time-recording machines to Prices' Patent Candle Company, Limited. They have also recently supplied further machines to the General Electric Company, Limited, making ten machines in all, in addition to which the company have just completed an installation of thirteen machines in Russia for the Vienna-Warsaw Railway.

MESSRS. CUTBILL, KING & COMPANY, Cross Keys House, 56-58, Moorgate Street, London, E.C., agents in the United Kingdom for Les Atéliers Métallurgiques (Société Anonyme de Construction), Belgium, inform us that, owing to the fact that most of the workmen have been mobilised, their works have been closed down. They are, therefore, unable to continue working on orders for English consumers, but everything possible will be done to minimise the delay in delivery when work is again commenced.

WE understand that Oxide, Limited, of Sutton, Surrey, are considering the practicability of starting the manufacture of ferro-alloys, in view of the undoubted scarcity and high prices prevailing at the moment. As is well-known many of these alloys are German productions, and now that Continental shipments have practically ceased, the probability is that the manufacture of ferro-alloys will be taken up more extensively in this country than has hitherto been the case, particularly as most likely consignments of the special ores essential will be diverted from German to British ports.

ORDERS have been given for a commencement to be made at the Crewe works of the London and North-Western Railway Company with the construction of a new series of six-wheeled coupled bogie four-cylinder locomotives, as also a further series of four-wheeled coupled bogie engines for main-line service. During the first half of the current year 21 eight-wheeled coupled superheater goods engines were turned into traffic, as also 14 passenger locomotives of the "Prince of Wales" type, and it is anticipated that the total output for the current year will be equivalent to 70 heavy main line locomotives.

ON Saturday, August 22, about 50 members of the Birmingham Branch of the British Foundrymen's Association paid a visit of inspection to the Birmingham Central Fire Station, Upper Priory, which is one of the best equipped in the kingdom, and is furnished with some of the most up-to-date appliances now in use for dealing with fires, including four of the latest types of motor engines. They comprised one motor turbine, one motor tender, one motor turntable and water tower combined, with a fourth engine of smaller dimensions, and in addition there are in reserve two horse-drawn engines. Special interest was taken in the combined motor turntable and water tower, which comprised a sort of folding ladder operated by a gas engine. The ladder unfolds on a mechanical turntable and can be extended in less than a minute to a height of 90 ft. at the same time conveying water hose, so that the water can be instantly poured over the top of the highest building. The brigade is now able to cope with every building in Birmingham, with one doubtful exception. A demonstration of this machine was given, and another demonstration with a hand-operated extension ladder combined with a hook ladder. District Officer Hayes explained that the demonstrations were given at some disadvantage, as 66 men of the staff of 150 have left to take part in the war, and the places of fifty of these have yet to be filled.

THE evening foundry-trade class at Napiershall School, Glasgow, will be resumed on Monday, September 14. The work covered by the class includes the following:—Moulding: Instruction on how to make and read drawings and estimate the cost of work; determining the weight of castings and other workshop calculations; moulding sands; hydrostatic and gas pressures in moulds; liquid shrinkage; weighting of moulds; venting and ramming; warping and fracture of castings; green-sand, dry-sand, and loam moulding; open-sand; single and double turnover; two-part, three-part, cheek-box and snap-flasks; plate moulding; embossing by claying out and reverse moulding; moulding from guides; machine moulding; false cores and drawbacks; mixture of metals for different types of castings in iron and brass; cupola practice; brass alloys; brass foundry practice, etc. Pattern Making: Workshop drawing; workshop calculations; patterns in wood, lead, and stucco; shell, solid and skeleton patterns; propeller work; loam boards and strickles; guides and apparatus for non-pattern moulds; construction of core boxes; tooth gearing, involute and cycloidal; laying off large curves. Stucco patterns will be made illustrating track, centre and spindle work. A special class for apprentice moulders is being instituted this session, and in connection with this class an open meeting for foundry foremen and others interested in the training of apprentice moulders will be held in Napiershall School, Glasgow, on September 11, at 7.45 p.m., when a Paper will be read on "Cupola Practice" by Mr. R. R. McGowan, the principal teacher. Following this a discussion will take place on the "Training of Foundry Apprentices;" representatives from the Glasgow School Board and the foundry trade will take part in the discussion. The object of this meeting is to further the movement recently taken up on this question by the British Foundrymen's Association.

Deaths.

MR. WM. WRIGLEY, engineer and iron and brass-founder, of Chesterfield, died recently at the age of 72 years.

THE death is announced of Mr. J. Scott, head of Scott Brothers, engineers and machine tool makers, West Mount Ironworks, Halifax, at the age of 79 years.

MR. C. C. CLARK, governing director of George Clark & Sons (Hull), Limited, metal merchants, coppersmiths and brassfounders, Waterhouse Lane, Hull, died recently. The deceased gentleman, who founded the firm in 1859, had been associated with the copper and brass industry practically all his life.

THE death is announced from Cologne, at the age of 67 years, of Herr Ludwig W. Breuer, one of the founders of the well-known machine-tool firm, the Kalker Werkzeugmaschinenfabrik, Breuer, Schumacher & Company, of Kalk, Cologne. The deceased was one of the pioneers of the machine-tool industry in Germany.

THE death is announced of Colonel C. E. Parker-Jervis, the chairman of Scott Brothers, Limited, iron and metal merchants and agents, Newcastle. The deceased gentleman, who was a son-in-law of the late Mr. W. H. Scott, has been chairman of the company since Mr. Scott's decease some 12 years ago. He lived in London, but died at Harrogate, where he was staying for his health.

MR. E. J. HATTERSLEY, senior partner in the firm of E. J. Hattersley & Company, Central Steel Works, Edward Street, Sheffield, died recently at his residence, the Mount, Silver Hill, Ecclesall, Sheffield, at the age of 66 years. In addition to the manufacture of crucible steel, the firm carry on the business of iron merchants, carrying large stocks in their own warehouses. We understand that the business will be continued by Mr. J. A. Clarke, the remaining partner.

Parliamentary Notes.

Patents and Designs Bill.

This Bill was read a second time in the House of Lords on Tuesday, August 4.

Trade Marks Bill.

This Bill passed through Committee in the House of Lords on Tuesday, August 4.

Patents Held by Alien Enemies.

A bill to amend the Patents Act passed a fortnight previously and giving further power to the Board of Trade to make regulations under which patents and designs may be held by alien enemies was read a first time in the Lower House on August 25. Mr. Runciman said that the Act already passed was not as full as it might have been.

Articles of Commerce.

Mr. Runciman brought in a Bill in the House of Commons on August 25 to provide for a return of articles of commerce. It gave power during the war to obtain information concerning stocks of articles of commerce, so as to enable a decision to be come to whether articles were unreasonably withheld. This was supplementary to the Bill passed a fortnight ago, and it was required because the Government had found difficulty in obtaining information in some quarters as to what stocks were held.

War Office Contracts.

In the House of Commons, on Wednesday, Mr. Godfrey Collins asked the Financial Secretary to the War Office whether in order to facilitate business he could arrange to expedite payment for works under contract for the War Office.

Mr. Harold Baker (Financial Secretary):—In order to assist contractors in the present financial emergency the War Office is prepared to make payments on account of work done at intervals of a fortnight instead of a month, and to consider applications for a reduction in the "reserve" withheld until the accounts for service are finally passed if it is shown that this exceeds any probable liability of a contractor.

German Patents.

In the House of Commons, on August 10, Sir F. Cawley asked whether the President of the Board of Trade was aware that a large number of men were likely to be thrown out of work in consequence of being unable to get the raw material from Germany, whether he was aware that many of the necessary materials could be manufactured in this country, and whether under the circumstances licences would be granted to English firms to use the patents during the continuance of the war.

Mr. Runciman replied that the Board of Trade had already taken power to deal with cases similar to those mentioned by the hon. gentleman. The Board of Trade could make rules dealing with these cases and the matter was under consideration.

Ferro-Manganese Exports.

In the House of Commons, on August 25, Colonel T. Hickman asked the President of the Board of Trade if, considering the statement in the Press that the price of ferro-manganese was from $100 to $150 per ton, at Baltimore, that they were expecting shipments from this country to relieve the tension, that the price for the article in England had advanced during the last ten days from £8 5s. to £12 per ton; considering that ferro-manganese was absolutely essential to the manufacture of all classes of steel for guns, gun carriages, armour plates, etc., and considering the great temptation to English ferro-manganese makers to export this important necessary article owing to the advance in price between the two countries (viz., £12 as against £30 per ton), the President of the Board of Trade would consider the advisability of prohibiting the export of ferro-manganese from this country.

Mr. Runciman replied that by proclamation, dated August 5, issued under the Exportation of Arms Act, 1900, manganese (including ferro-manganese) was prohibited to be exported from the United Kingdom to foreign ports of Europe and on the Mediterranean and the Black Sea, with the exception of France, Russia (other than the Baltic ports), Spain and Portugal. The question of extending the prohibition so as to cover exports to all destinations would be considered.

Personal.

Mr. J. M. Allan has resigned his seat on the board of R. & W. Hawthorn, Leslie & Company, Limited.

Mr. J. R. Geary has been re-elected a directing-manager of the Shiba-ura Iron Works Company, of Yokohama, Japan.

The late Mr. A. M. Fowler, of Hendersyde, Ascot, Berkshire, the eminent Manchester engineer, left estate valued at £7,077 gross.

Mr. C. O. Bannister has joined Messrs. Edward Riley & Harbord, metallurgical chemists, 2, City Road, Finsbury Square, London, E.C.

Mr. C. Williams, of the open-hearth department of the Illinois Steel Company, U.S.A., has been appointed superintendent of the open-hearth plant of the Tata Iron & Steel Company, Limited, in India.

Mr. E. Leadbeater, steel and file manufacturer, of the firm of Leadbeater & Scott, left estate valued at £22,876.

Mr. J. P. Crosbie has been elected a director of Hadfields, Limited.

Mr. P. Williams has now taken over the general management of the works of John Lysaght, Limited, Normanby Park Steel Works, Scunthorpe, Lincs., in place of Mr. F. W. Cooper.

Mr. J. Taylor, secretary of the Dudley Anvil and Vice Makers' Association, has been the recipient of a presentation from the members of the Association in recognition of his long and continued work on their behalf.

Mr. S. G. Smith, hitherto foundry manager to Cole, Marchent & Morley, Limited, Prospect Foundry and the Hammerton Street Ironworks, Bradford, has been appointed assistant foundry manager to the British Westinghouse Electric and Manufacturing Company, Limited.

Mr. W. J. Jago, an Admiralty surveyor, who for the past eight years had been associated with the Port Talbot Steelworks, has been the recipient of a presentation from the officials and men on his retiring from the position.

Mr. A. J. Margetson, assistant professor at the City and Guilds (Engineering) College, Kensington, has been appointed by the Executive Committee of the City and Guilds of London Institute to the professorship of civil and mechanical engineering at the Technical College, Finsbury, in place of Professor E. G. Coker, who has been appointed to the chair at University College.

Mr. William H. Ellis, a director of the firm of John Brown & Company, Limited, has been elected at Sheffield the Master of the Cutlers Company of Hallamshire. The election was postponed because of the belated return of Mr. Ellis from a holiday in Switzerland. Mr. A. E. Bingham, a director of Walker & Hall, Limited, was elected senior warden of the Cutlers Company.

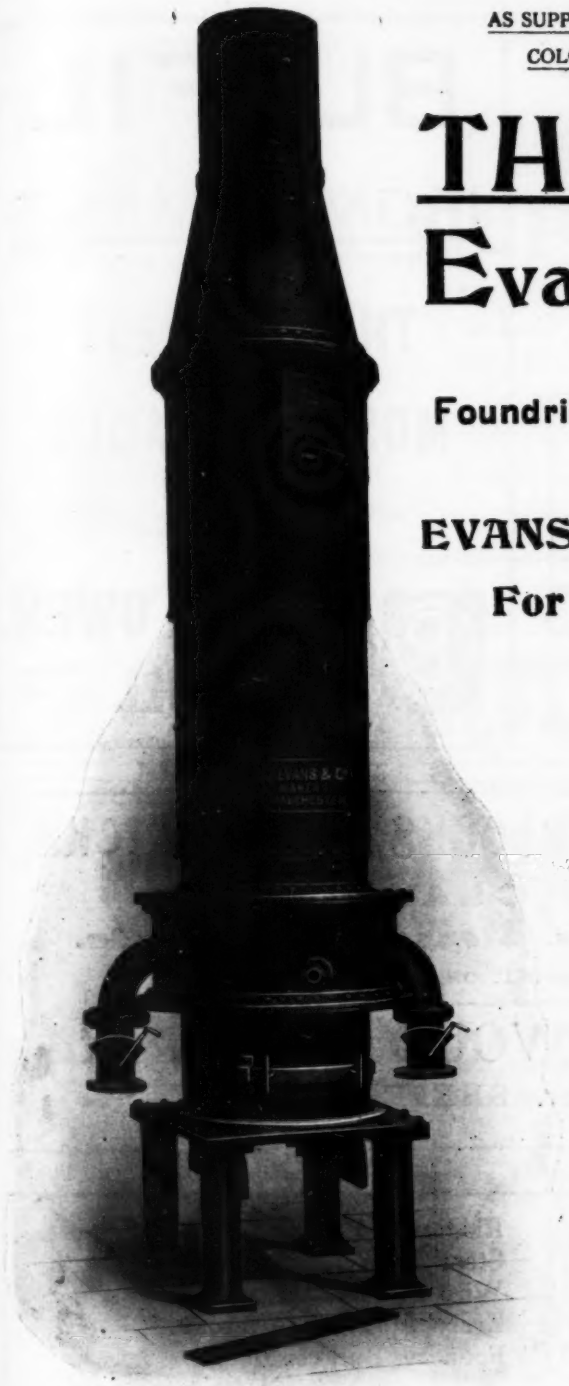
Mr. Daniel Kemp has been appointed to succeed Mr. J. W. Reed as general manager of the engine works department of Palmers Shipbuilding & Iron Company, Limited, Jarrow. The following other appointments have also been made:—Mr. A MacFarlane has been appointed chief assistant to Mr. Kemp, and Mr. William Brown outside manager. Mr. MacFarlane and Mr. Brown have for some time occupied responsible positions in the engine works department of the company. Mr. R. Fullerton, recently of Clydebank, has also been appointed an assistant manager in this department. The above appointments have been made owing, we understand, to the immediate retirement of Mr. Reed from the works.

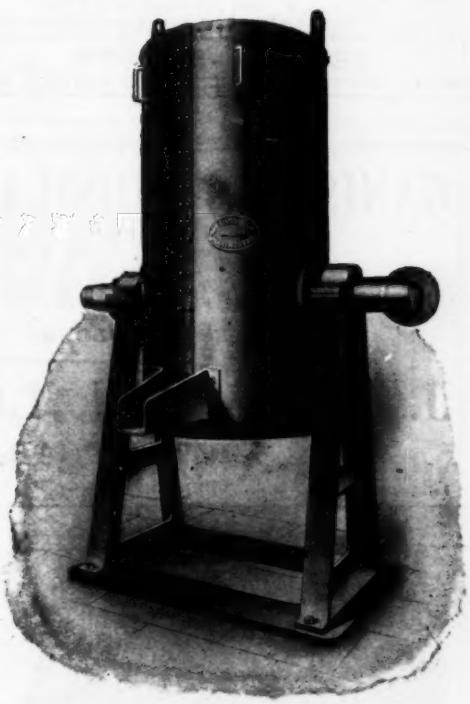
AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.

THE Cupola.
Evans's Rapid.

Foundries Completely Furnished.

EVANS'S NEW CUPOLETTE
For Emergency Work.





James Evans & Co.,
Britannia Works,
Blackfriars,
MANCHESTER.

Telegrams: "LADLES, MANCHESTER."
Telephone: 2297 CENTRAL, MANCHESTER.

New Companies

Schofield Syndicate, Limited.—Capital £1,000 in £1 shares, to carry on the business of engineers. Registered office : 38, Masterman Road, East Ham, London, E.

William Allen, Manchester, Limited.—Capital £20,000 in £1 shares, to carry on the business of engineers, brass and iron founders, etc. The first directors are W. and D. A. Allen, G. H. Taylor, R. Sharples, and G. H. Pearson.

Oatey & Martyn.—Capital £8,000 (£1), to take over the business of engineers, metal founders, etc., carried on by C. J. Ennor and E. G. Martyn (executors of the will of the late J. Martyn) at Wadebridge, Cornwall, as Oatey & Martyn.

FANS AND BLOWERS AND OTHER FOUNDRY MACHINERY FOR SALE.

BARGAINS FOR PROMPT CASH.

No. – Root's Blower "Acme" for 20 smiths' fires.
One ditto, with high-speed Vertical Engine combined.
Thwaites Roots Blower, 11½" discharge.
"B" Roots Blower by Alldays.
Foundry Blowing Fan, 36" impeller, 19" discharge, also 9½" round outlet to fit on same.
14" Schiele patent Blast Fan.
Lloyd's patent Blowing Fan for 50 smiths' fires.
New Roots pattern Blower, 5".
Silent Blowing Fans, 8½", 8" and 9" discharge.
Ball Mill, with drum, 2' 7" and 5' 8" outside by 1' 7" wide.
Improved Foundry Core Ovens, portable type and for fixing in wall.
4' 6" diameter UNDERGEARED LOAM MILL, with stationary pan.

CHARLES D. PHILLIPS.

EMLYN & CENTRAL ENGINEERING WORKS, NEWPORT, MON.

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THE

IRON CEMENT

(Quick or slow setting grades)

IS

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MOST RELIABLE

for all purposes.

Unaffected by oil, steam, or water.

Sole manufacturers—

RUDD & OWEN

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Telegrams "Theripnene," Hull.

HULL

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FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

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DEEPCAR, nr. SHEFFIELD.

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Riddles and Sieves for Foundry use.
Steel Wire Casting Brushes.
Wire Machine Guards.
Every kind of Wirework.
Foundry Buckets.

PROCTER BROTHERS,

Riddle Makers, etc., LEEDS.

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CUPOLA FANS.

Made in eight sizes from 10-in. to 35-in. diameter, and suitable for melting ½ to 20 tons per hour at pressures from 12—30 inches Watergauge.

Cast Iron Casings and Ball Bearings.

Double Inlet. All Types of Discharge.

Write for Bulletin No. 2028F.

DAVIDSON & CO., LIMITED,

Sirocco Engineering Works,

BELFAST.

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE BRITISH ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time. We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Collieries, Ltd., Cardiff.

Telegraph : ELDER, CARDIFF. Telephone : 4640 and 4641.

MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining on the first day of the current month.

Pig-Iron.

	Aug. 28. s. d.
Cleveland.	
Cleveland No. 1	54 0
,, No. 3	51 6
,, No. 4 foundry	51 3
,, No. 4 forge	51 0
,, Mottled	50 6
,, White	50 6
East Coast hematite, mixed Nos.	70 0
Cleveland warrants	51 4

Above prices are for early f.o.b. deliveries, and as regards Cleveland iron are for G.M.B. brands. The warrant quotations are the sellers cash prices.

	s. d.
Scotland.	
Standard Foundry (Glasgow Market settlement price)	50 7½
Warrants, ditto	57 0

Makers' prices:—	s. d.		s. d.
Gartsherrie No. 1	70 0	No. 3	65 0
Coltness No. 1	—	No. 3	—
Summerlee No. 1	70 0	No. 3	65 0
Langloan No. 1	72 0	No. 3	67 0
Calder No. 1	70 0	No. 3	65 0
Clyde No. 1	69 6	No. 3	64 6
Carnbroe No. 1	68 6	No. 3	64 6
Monkland No. 1	64 6	No. 3	63 0
Shotts No. 1	70 0	No. 3	65 0

(All deliverable alongside Glasgow.)

Glengarnock	No. 1	71 0	No. 3 66 0
Eglinton	No. 1	64 0	No. 3 63 0

(All deliverable alongside Ardrossan.)

Dalmellington	No. 1	65 0	No. 3 63 0

(Deliverable alongside Ayr.)

Carron	No. 1	70 6	No. 3 65 6

(F.a.s. Grangemouth.)

	s. d.	s. d.
Lancashire.		
Lancashire No. 3 foundry f.o.t.	—	—
Lincolnshire No. 3 foundry	—	61 0
Derbyshire No. 3 foundry	—	63 0
Staffordshire No. 3 foundry	—	61 0
Cleveland No. 3 foundry	—	61 3

(All delivered equal Manchester.)

Scotch No. 3	Gartsherrie	—	69 0
	Glengarnock	—	67 6
	Eglinton	—	67 6
	Summerlee	—	69 0

(Delivered Manchester Docks.)

	s. d.	s. d.
North-West of England.		
Bessemer mixed numbers net f.o.b.	74 9	75 0
Hematite warrant net cash	—	66 0
Lorn cold-blast charcoal iron	180 0	190 0

	s. d.	s. d.
The Midlands.		
Staffs. Common forge	59 0	60 0
Staffs. Part Mine forge	60 0	61 0
Staffs. Best All Mine	85 0	90 0
Staffs. Cold Blast	—	130 0

Strong forge, about 1s. less than grey forge; Mottled and White, about 2s. less than forge; Foundry No. 3, 3s. to 5s. above forge; No. 1 and No. 2, from 1s. 6d. to 2s. above No. 3; No. 1, about 2s. above No. 2.

Northampton foundry	—	—
North Staffs. foundry	—	—
Derby foundry	—	—
Nottinghamshire foundry	—	—
Leicestershire foundry	—	66 6
Shropshire Cold-Blast	—	132 6

(Delivered South Staffordshire Works, net cash monthly.)

	s. d.	s. d.
Lincolnshire.		
Forge	—	55 0
Grey forge	—	55 0
Basic	56 0	54 0
No. 3 foundry	56 0	57 0
No. 4 foundry	55 6	56 0

F.o.t. Makers' works.

	s. d.	s. d.
South Wales.		
Welsh Hematite	74 0	75 0

Ferro-Alloys.

Net, Delivered Sheffield Steel works.

	£ s. d.	£ s. d.
Ferro-chrome: 4/6% carbon. Basis 60%, scale 10s. per unit. Per ton		—
Ferro-chrome: 6/8% carbon. Basis 60%, scale 10s. per unit. Per ton		—
Ferro-chrome: 8/10% carbon. Basis 60%, scale 8s. 6d. per unit. Per ton		—
Ferro-chrome · Specially refined, guaranteed maximum 2% carbon, broken to small pieces for use in best quality crucible steels. Basis 60%, scale 22s. per unit. Per ton		—
Ferro-vanadium: 33/40% Va., per lb. of Va. contained in the alloy		—
Ferro-silicon: 45/50%. Basis 50%, 5s. scale per unit Per ton		—
Ferro-titanium: 15/18%, per pound, flat		—
Ferro-molybdenum: 70/80% Mo. per pound of Mo. contained		—
Ferro-phosphorus: 20/25%. Per ton		—
*Ferro-manganese 80%	12 10 0	
,, export		—

* F.o.b. Liverpool.

Iron Castings.

	Cleveland. £ s. d.	£ s. d.
Columns (plain)	7 7 6 to	7 12 6
Pipes, 1½ to 2½ in.	6 7 6	6 12 6
,, 3 to 4 in.	5 17 6	6 0 0
,, 5 to 8 in.	5 12 6	5 15 0
,, 10 to 16 in.	5 15 0	—
,, 18 to 24 in.	5 15 0	—
Chairs	4 5 0	4 6 0
Floor plates (open sand)	3 10 0	3 12 6

(At works.)

Non-Ferrous Metals.

	£ s. d.
Copper.	
Standard, Cash	—
Three months	—
Electrolytic	60 0 0
Tough	—
Best selected	61 0 0
Tin.	
Standard, Cash	—
,, Three months	—
English Ingots	143 0 0
Bars	144 0 0
Refined	—
Spelter.	
Silesian	37 0 0
Specials	—
Hard	—
British	40 0 0
Lead.	
Soft foreign	21 10 0
English	21 10 0
Antimony.	
Regulus	34 10 0 to 37 0 0
Aluminium.	
Virgin Metal, 98/99% ..per ton	—
***Chromium (Metallic).**	
98/99% purity per lb.	—
***Nickel.**	
In cubes, 98/99% purity Per ton	—
***Tungsten Metal Powder.**	
96/98% purity per lb.	0 5 6
***Molybdenum Metal.**	
96/98% purity.. per lb. 10s. 6d. to	—
***Cobalt Metal.**	
97% purity per lb. 6s. 9d. to	—
Quicksilver.	
75 lb. bottle	7 0 0

* Net, Delivered Sheffield Works.

Scrap Iron and Steel.

	s. d.	s. d.
Cleveland.		
Steel scrap, heavy melting	50 0 to	52 6
Iron scrap cast (cupola metal)	52 6	55 6
London (f.o.b.).		
Heavy steel		52 6
Light ,,		35 0
Heavy cast		50 0

Non-Ferrous Scrap.

London merchants quote, delivery free, and subject to market fluctuations:—

	J. B. Garnham and Sons. £ s. d.	A. Joseph. £ s. d.
Brass	40 0 0	42 0 0
Clean copper	57 0 0	58 0 0
Brassiery copper	54 0 0	52 0 0
Old lead	18 0 0	19 5 0
Tea lead	—	17 15 0
Old zinc	18 0 0	23 0 0
Hollow pewter	90 0 0	10[illegible] 0 0
Black pewter (shaped)	60 0 0	65 0 0
Gun metal	50 0 0	53 0 0
Aluminium (cuttings)	56 0 0	62 0 0

Stocks.

Pig-Iron in Public Store.

	Aug. 27. Tons.	Inc. + or Dec. — since Aug. 28 1913. Tons.
Connal's at Glasgow Scotch	1,000	No change.
Ditto other makes	2	—18
Connal's at Middlesbrough	93,009	— 94,787
Connal's at Middlesbrough hematite	—	No change.
West Coast hematite	3,085	—16,865

Metals.		
Copper, Europe and afloat	—	—
Tin, London Holland, U.S.A. and afloat	—	—

Coke.

	s. d.	s. d.
Middlesbrough.		
Gas Coke	—	11 6
Foundry Coke	21 0 to	22 0
Furnace coke	—	18 3

	F.o.b. Dunston. s. d.
Newcastle-on-Tyne.	
FOUNDRY COKE—	
Original Garesfield	20 6
Mickley	19 6
Stella Garesfield	20 0
Priestman's Garesfield	20 6
Consett Garesfield	20 6
Newcastle gas coke	12 6

	s. d.	s. d.
Cardiff.		
Special foundry coke	28 0 to	30 0
Foundry coke	22 0 to	25 0
Furnace coke	18 0 to	20 0

Leeds.	
Furnace coke	—
Birmingham.	
Foundry coke	—
Furnace ,,	17 0 to 19 0
Gas ,,	—
Glasgow.	
Foundry coke	—
Furnace ,,	—
Gas ,,	—
London.	
Foundry coke	—
Gas ,,	—

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.

Manufacturers of all

FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

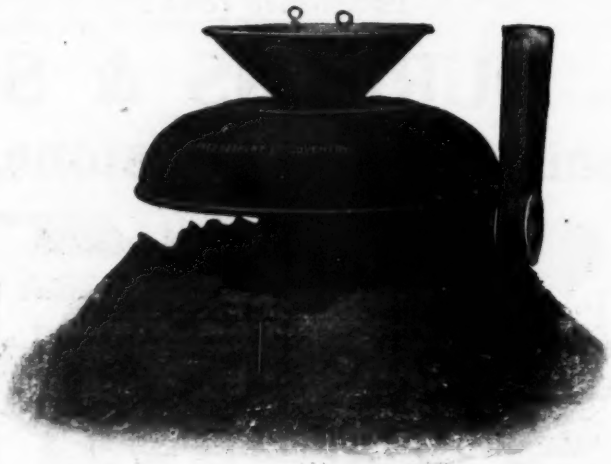
Improved Foundry Rattler or Fettling Drum.

These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.



Patent Sand Mixer

Uses up more old sand than has hitherto been considered possible.

Our Patent Sand Mixer has the following desirable advantages.

The sand is thoroughly aerated, rendered light and loose in texture and of even temper.

Previous milling of the sand is unnecessary.

Seven hundredweights of sand dealt with per minute.

All bearings are ball bearings.

All gears are casehardened steel.

All gears and bearings run in an oil-bath rendering them practically everlasting.

Cages easily examined and cleaned.

Cages do not clog as there are no curved passages.

Machines can be seen in operation in our foundries, Edgwick, Coventry.

ALFRED HERBERT, Limited,

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SITUATIONS VACANT AND WANTED.

WANTED, AGENTS calling upon Ironfounders, to introduce "Shally's Steel Wire Brushes." Good commission to suitable men with connections.—Write SHALLY & Co., Wire Brush Manufacturers, 55, Great Thornton Street, Hull.

POSITION wanted as FOUNDRY FOREMAN or ASSISTANT, by an Englishman 30 years of age, returning to England Jan. 1, 1915. Has had 13 years' experience in Moulding in all its branches, and can furnish excellent references from reputable and leading concerns in England, Canada, and United States.—Write A. MINGAY, Instructor of Foundry Dept., Allis Chalmers, Electrical Engineers, Norwood, Ohio, U.S.A.

FOR SALE AND WANTED.

CORE GUM. ROSIN. CORE GUM. ROSIN.

IT will Pay you to write me for Samples and Prices. EDGAR KENYON, Direct Importer.

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HALL'S INVINCIBLE SAND MIXERS are now successfully in use for preparing NEW SANDS and UTILIZING OLD SANDS in some of the LARGEST FOUNDRIES.—Write for information and prices to C. E. V. HALL, Paradise Chambers, Sheffield.

TO BRASS FOUNDERS AND OTHERS.—For SALE, almost new HAND MOULDING MACHINE, SAND MILL, ROTARY SIEVE, First-Class GAS ENGINE, LATHES, and other Machines.—Apply Box 490, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

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EXCELLENT OPENING for an up-to-date and LARGE FOUNDRY in the Oldham district. 50 to 100 tons of orders per month could no doubt easily be procured by Engineering Firms in the locality.—Application for further particulars, Box No. 520, Offices of THE FOUNDRY TRADE JOURNAL, 165 Strand, London, W.C.

WANTED to RENT or PURCHASE, in the neighbourhood of Manchester, IRON FOUNDRY. Must be conveniently situated with Railway Siding, and, if possible, Canal.—Apply, stating full particulars as to area of property, size of cupolas, etc., etc., to "FOUNDRY," c/o Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

JOHN WILLIAMS (BIRMINGHAM SAND), Ltd.,

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ESTABLISHED OVER A CENTURY.

SUPPLY

FOUNDRY SAND

To the Requirements of all Users.

Also ROLL SAND of all descriptions ready for use.

FRODAIR

SPECIAL PIG IRON

for

CYLINDERS, CHILLED CASTINGS, MACHINE CASTINGS, and any :: :: FOUNDRY PURPOSE. :: ::

ASK FOR OUR SUGGESTIONS FOR ECONOMICAL IRON MIXTURES.

THE FRODAIR IRON & STEEL CO., LTD.,

Fenchurch House, LONDON, E.C.

Stamped Brass Letters.

All kinds of Letters for Pattern-making and Foundries supplied from stock at very advantageous prices.

Solid (cast) Brass Letters

Walco, Ltd.,

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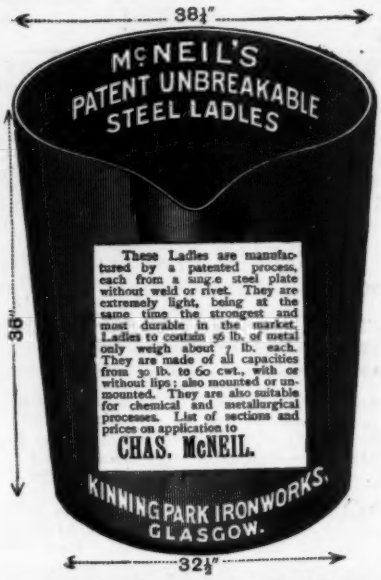
Birmingham.


38¼"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
36"
32½"

Can also be made in Aluminium.

WHITTAKER'S IMPROVED MOULDING MACHINE

By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 ft. diameter can be made.

The most complete and efficient machine hitherto introduced to Engineers.

All Machines warranted to Mould with the greatest accuracy and precision.

GEARING WHEELS

Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.

ROPE & BELT PULLEYS.

WM. WHITTAKER & SONS, LTD.,

SUN IRON WORKS, ***OLDHAM.***

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625	Anglo-Mexican Petroleum Products Co., Ltd.	Finsbury Court, Finsbury Pavement, E.C.	Mexproduct, Ave., London	City 2704
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C. iii.	Britannia Foundry Co.	Coventry	Stoves, Coventry	251
617	British Aluminium Co., Ltd.	109, Queen Victoria Street, E.C.	Cryolite, London	4315 London Wall
625	British Binderit Co., Ltd.	317, High Holborn, London, W.C.	Bindercomp, Holborn, London	950 Holborn
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626 & 661	Evans J., & Co.	Manchester	Ladles, Manchester	2297
C. ii.	Everitt & Co.	40, Chapel Street, Liverpool	Persistent, Liverpool	1134 Central (3 lines)
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	Glasgow Patent Moulders Blacking Co.	26, Fleming St., Port Dundas, Glasgow	Moulders, Glasgow	—
614	Goldendale Iron Co., Ltd.	Tunstall, Stoke-on-Trent	Goldendale, Tunstall, Staffs	—
616	Gray, Thomas, E., & Co.	71, Lincoln's Inn Fields, Kingsway, London, W.C.	Papplewick, London	1193 City
C. ii.	Hall John & Co. (Stourbridge). Ltd.	Fire Clay Works, Stourbridge	Hall, Stourbridge	55 Stourbridge
666	Herbert, Alfred, Ltd.	Coventry	Lathe, Coventry	Coventry 860
616	Hislop, R. & G.	Paisley	Gas, Paisley	331 Paisley
619	Keith, James, & Blackman, Co., Ltd.	27, Farringdon Avenue, London	James Keith, London	6194 H'lb'rn(4lines
619	King Bros. (Stourbridge), Ltd.	Stourbridge	King Bros., Stourbridge	—
	London Emery Works Co., Ltd.	Park, Tottenham	Naxium, London	99 Tottenham
662	Lowood, J. Grayson, & Co., Ltd.	Deepcar, nr. Sheffield	Lowood, nr. Sheffield	18 Stocksbridge
	Marshall, H. P., & Co.	Leeds	Specialty, Leeds	1909 Leeds
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625	McGowan, Wild & Co.	206, Lower Hurst Street, Birmingham.	Logic, Birmingham	1816 Midland
	McLain's System	710, Goldsmith Bldg, Milwaukee, U.S.A.	—	—
668	McNeil, Chas.	Kinning Park, Glasgow	McNeil, Glasgow	X 155
667	Naish & Croft	141, Whitehead Road, Aston Manor	—	—
619	Olsen, William	Cogan Street, Hull	Wm. Olsen, Hull	Nat. 1184
623	Phillips, Charles D.	Newport, Mon.	Machinery, Newport	—
C. iii.	Phillips, J. W. & C. J.	23, College Hill, E.C.	Colloquial, London	10112 Central
622	Pickles, James, Ltd.	Laurel St., Leeds Rd., Bradford	Pickles, Laisterdyke	3723 Bradford
618	Piftin, Ltd.	2, Fen Court, Fenchurch Street, E.C.	Russesco, London	11230 Central
623	Portway, Chas., & Son	Halstead, Essex	Portway, Halstead	10 Halstead
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	Rudd & Owen	Hull	Therpinene, Hull	1223 Nat.
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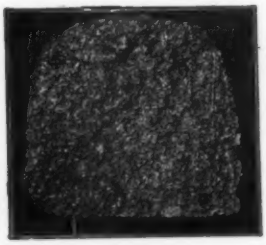

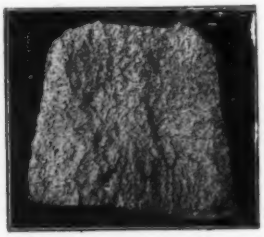

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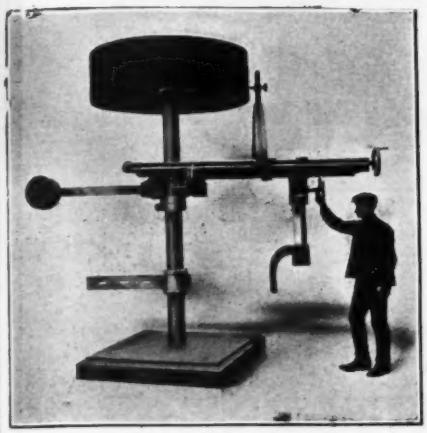

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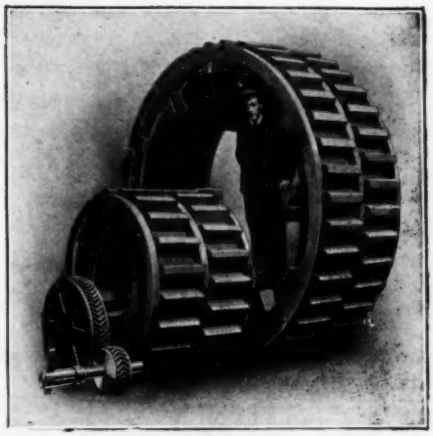

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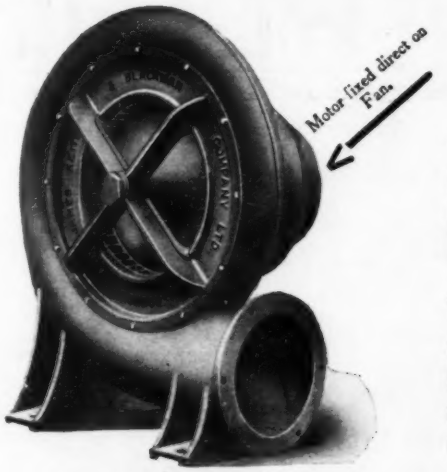

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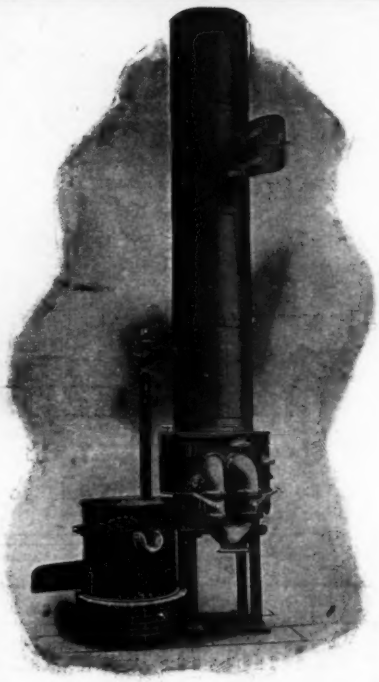

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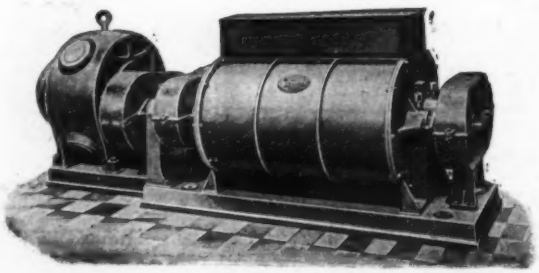

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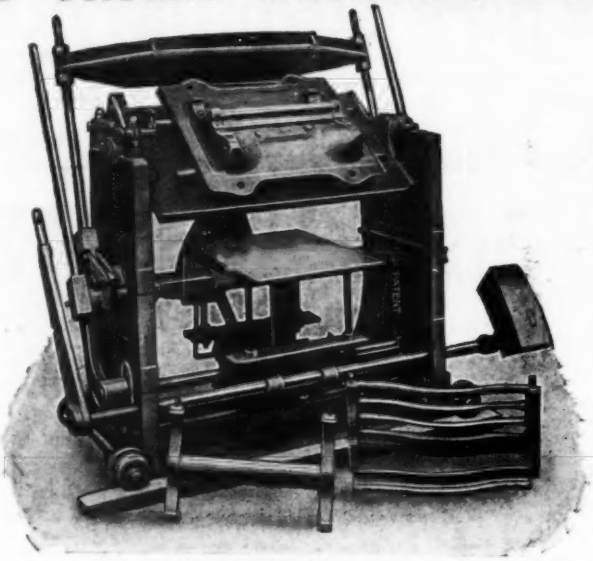

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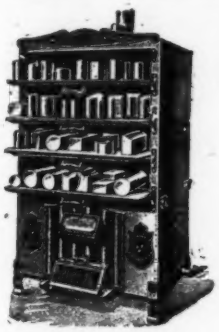

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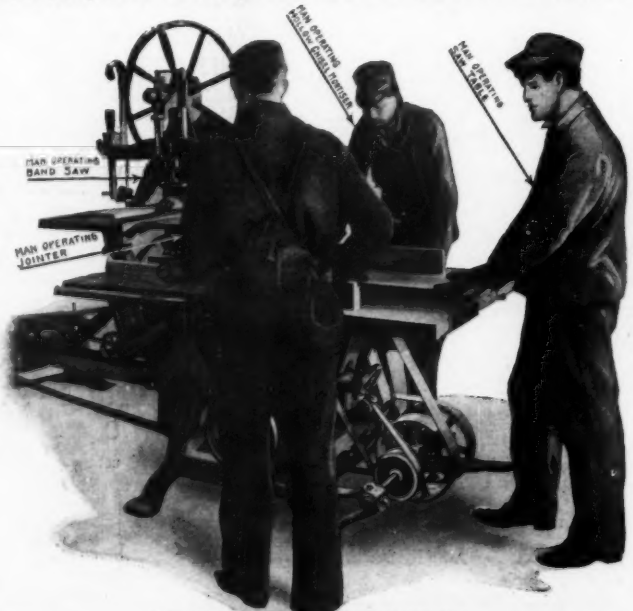

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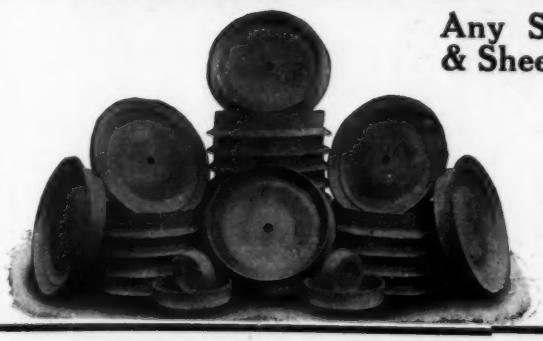

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